STATE OF MINNESOTA
MINNESOTA POLLUTION CONTROL AGENCY

In the Matter of Proposed
Rules Governing Municipal
Solid Waste Combustor Ash
Facility Permits, and
Testing and Disposal of Municipal
Solid Waste Combustor Ash

STATEMENT OF NEED AND REASONABLENESS

Minnesota Pollution Control Agency
520 Lafayette Road
St. Paul, Minnesota 55155-3898

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ACKNOWLEDGMENT

The Agency wishes to acknowledge the assistance of the Ash Rules Task Force members and other interested parties who participated actively in developing the proposed municipal solid waste combustor ash rules. The cooperation and input of these parties has been an invaluable tool for establishment of comprehensive rules.

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I. INTRODUCTION

The proposed rules govern management of ash from combustors which burn mixed municipal solid waste. Some of the proposed rules are completely new material and some are amendments to Minn. Rules chs. 7001 and 7035. The proposed rules have been developed as required by Minn. Stat. § 115A.97, subd. 3 (Appendix I). Specifically, the proposed rules govern the testing, storage, disposal, and processing of municipal solid waste combustor ash. The proposed rules also govern future management of ash stored since 1988 under the Temporary Management Program for Mixed Municipal Solid Waste Incinerator Ash, which was established by the Minnesota Pollution Control Agency (hereinafter "Agency" or "MPCA") in September 1988 to comply with Minn. Stat. § 115A.97, subd. 4.

Note that "incinerator ash," "waste combustor residues" and "waste-to-energy residues" are other terms which are often used to refer to waste combustor ash. The Agency has chosen to use the term "waste combustor" for consistency with the Agency's proposed air quality rule amendments, and to use the term "ash" rather than "residues" because of its simplicity.

The proposed rules to regulate waste combustor ash are incorporated in the rules which regulate the management of solid waste (Minn. Rules ch. 7035). Ash which is managed in accordance with these proposed amendments to the solid waste rules is not subject to regulation under Minn. Rules ch. 7045, which governs management of hazardous waste. This reflects the Agency's resolution of the issue whether the solid waste rules or the hazardous waste rules should be applied to ash which results from combustion of mixed municipal solid waste. The Agency believes ash can be managed under the solid waste rules through promulgation of these proposed rules without compromising environmental protection.

The proposed amendments allow continued management of fly ash and bottom ash as combined ash. However, specific ash testing and land disposal facility design requirements are provided for bottom ash and fly ash alone to facilitate separate management for waste combustor owners or operators who choose to manage the two ash streams separately. Separate management of fly and bottom ash is also encouraged through establishment of three tiers of land disposal facility design requirements which are dependent on the leaching potential of the disposed ash. This matter is discussed in detail in a position paper on mixing bottom and fly ash (Appendix II).

This document is divided into nine parts. After this introduction, Part II presents an overview of the proposed rules. Part III presents the legal and historical background of waste combustor ash regulation. Part IV establishes the need for the proposed rules and Part V establishes the reasonableness of the proposed rules. Part VI presents the Agency's considerations of small business impacts, pursuant to Minn. Stat. § 14.115 (1990). Part VII presents the Agency analysis of the economic impacts of the proposed rule amendments, pursuant to Minn. Stat. § 116.07, subd. 6 (1990) and Minn. Stat. § 14.11, subd. 1 (1990). Part VIII presents the Agency analysis of the impacts of the proposed rule amendments on agricultural lands, pursuant to Minn. Stat. § 14.11, subd. 2 (1990). Part IX presents the Agency's conclusion regarding adoption of the rule amendments. Part X contains lists of exhibits, references and appendices relied upon by the Agency to support the proposed rules. The exhibits are available for review at the Agency offices located at 520 Lafayette Road in St. Paul, Minnesota 55155-3898.

II. OVERVIEW OF THE PROPOSED RULES

The Agency is proposing amendments to two existing rules: Minn. Rules chs. 7001 and 7035. Minn. Rules chs. 7001 and 7035 include specific permitting, design and operation requirements for specific types of solid waste management practices, such as land disposal, composting and processing of mixed municipal solid waste and land disposal of demolition debris. The amendments proposed at this time establish requirements specific to activities related to municipal solid waste combustor ash.

Minn. Rules ch. 7001 establishes permitting procedures for all agency programs. A number of amendments to Minn. Rules ch. 7001 are proposed which are

minor modifications to existing parts. In most cases, these additions simply extend or clarify the applicability of these parts to waste combustor ash. Proposed Minn. Rules pt. 7001.3480 is all new; it presents the requirements for a final application for a municipal solid waste combustor ash land disposal facility permit.

Amendments to various parts within existing Minn. Rules pts. 7035.0100 to 7035.2665 are proposed. Again, the purpose of many of these amendments is to extend and clarify applicability of these rules to waste combustor ash. Special requirements for vehicles or containers used for the transportation of municipal solid waste combustor ash are proposed in Minn. Rules pt. 7035.0800. New terms used in the all-new parts are proposed to be added to Minn. Rules pt. 7035.0300, Definitions.

Three all-new parts are also proposed, including: Minn. Rules pt. 7035.2885, Technical Requirements for Municipal Solid Waste Combustor Ash Land Disposal Facilities; Minn. Rules pt. 7035.2910, Municipal Solid Waste Combustor Ash Testing Requirements; and Minn. Rules pt. 7035.2915, Requirements for Temporary Program Type I and II Storage Facilities.

To complete the municipal solid waste combustor ash regulatory program, the Agency is in the process of developing two additional all-new parts to Minn. Rules ch. 7001 and two all-new parts to Minn. Rules ch. 7035. New Minn. Rules pt. 7035.2900 would govern municipal solid waste combustor ash utilization, and new Minn. Rules pt. 7035.2895 would regulate design and operation of municipal solid waste combustor ash processing facilities. The amendments to Minn. Rules ch. 7001 would establish permit application requirements for municipal solid waste combustor ash processing facilities and municipal solid waste combustor ash utilization projects. Although these new parts will also concern management of municipal solid waste combustor ash, their existence is not necessary for promulgation and enforcement of, nor compliance with, the rule amendments proposed at this time regarding testing and disposal of waste combustor ash.

The rules relating to utilization of ash will be proposed through separate rulemaking action because of the controversial nature of the issue. Utilization of municipal solid waste combustor ash in Minnesota is a new activity. The Agency believes it is desirable to hold further meetings with affected and interested parties to discuss ash utilization before rules are published for

comment in the State Register. The processing facility rules are following the same path as utilization rules because they relate to the subject of utilization.

III. LEGAL AND HISTORICAL BACKGROUND OF WASTE COMBUSTOR ASH MANAGEMENT RULES

A. HISTORICAL AND GENERAL INFORMATION REGARDING WASTE COMBUSTOR ASH

1. Waste Combustor Development

In the 1980 Waste Management Act, the Minnesota Legislature expressly stated one purpose of the Act as reducing the state's indiscriminate dependence on sanitary landfills as the primary means of managing solid waste. Minn. Stat. § 115A.02(a)(3). The legislature also established an order of preference among waste management practices: waste reduction and reuse, recycling, resource recovery through composting or incineration (combustion), and land disposal. Minn. Stat. § 115A.02(b). As a result of this initiative, a number of Minnesota counties and other governmental entities responsible for waste management planning developed solid waste combustors to reduce the volume of waste remaining which requires disposal, and to capture energy present in the waste.

Every waste management alternative other than reducing the amount of waste generated at the source results in some pollution or waste by-product which must be managed, be it air emissions from an aluminum smelter as part of recycling, or processing residuals from a waste composting system. The by-products from waste combustion include air emissions and ash. The Agency regulates air emissions through Minn. Rules ch. 7005. Ash regulation has occurred under Minn. Rules chs. 7035 and 7045. The purpose of these proposed rules is to establish one regulatory regime which applies specifically to waste combustor ash.

2. Ash Characteristics

Waste combustors produce two general categories of ash: fly ash and bottom ash. Fly ash consists of fine ash particles which are carried by air leaving the incineration unit and collected by air pollution control equipment. Bottom ash is the residue which remains after solid waste is burned in the combustion chamber. See Figure 1.

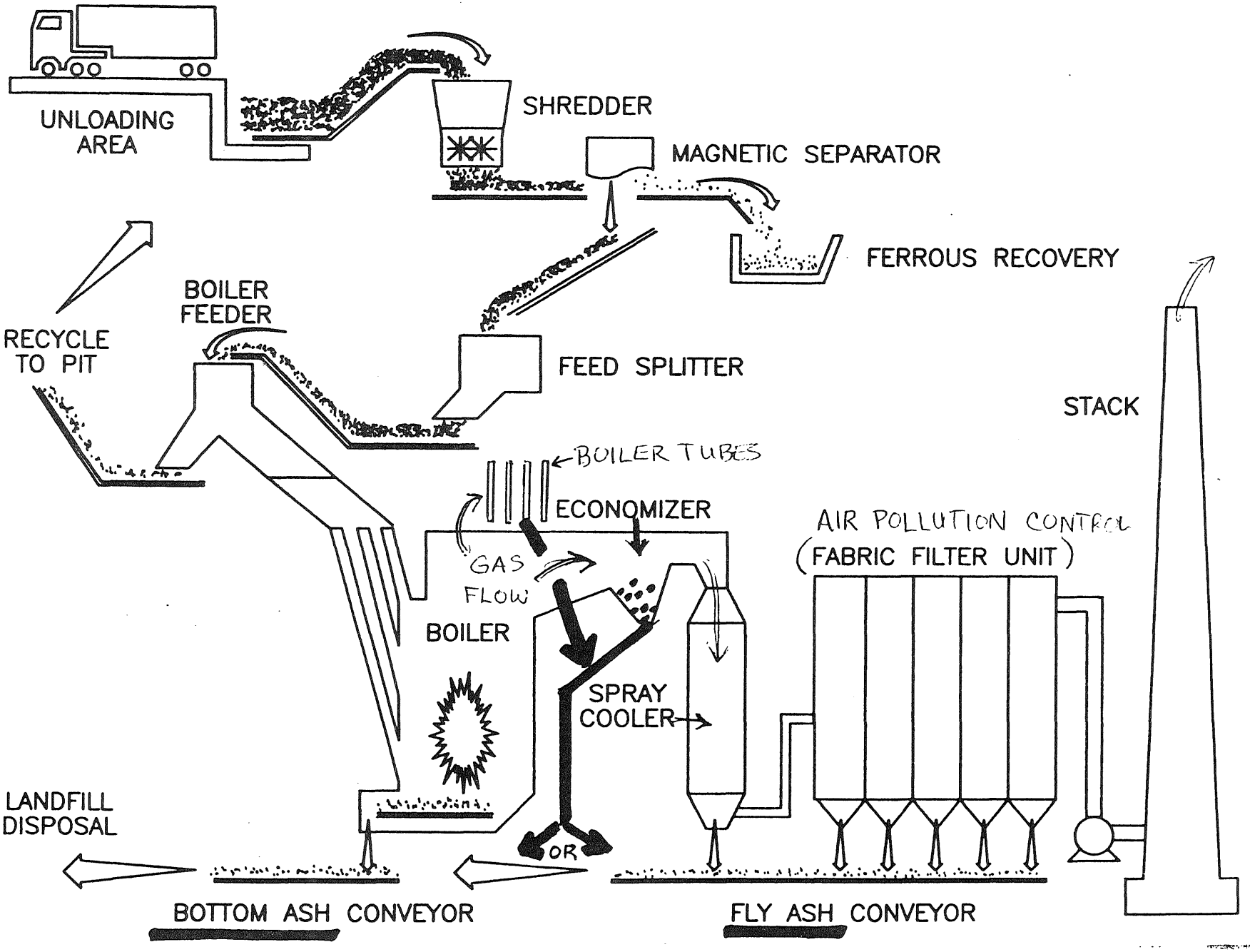

UNLOADING AREA
SHREDDER
MAGNETIC SEPARATOR
FERROUS RECOVERY
RECYCLE TO PIT
BOILER FEEDER
FEED SPLITTER
STACK
BOILER TUBES
ECONOMIZER
AIR POLLUTION CONTROL (FABRIC FILTER UNIT)
GAS FLOW
BOILER
SPRAY COOLER
LANDFILL DISPOSAL
OR
BOTTOM ASH CONVEYOR
FLY ASH CONVEYOR

Figure 1

Municipal solid waste contains a tremendous number of different components which are themselves made up of a tremendous variety of chemicals. When municipal solid waste is land disposed, in general it is the leachable volatile organic compounds which are most apt to cause pollution. When municipal solid waste is combusted, the organic compounds present are destroyed. However, metals and other inorganic compounds present in the waste, including toxic heavy metals such as lead, cadmium, and mercury, become concentrated as the volume of waste is reduced. Combustion may also create products of incomplete combustion including dioxins and furans, which sorb onto small particles which are collected as fly ash. Fly ash also typically contains higher concentrations of heavy metals; metals such as lead, cadmium, and mercury are partially volatilized at the high temperature of the waste combustor and become entrained in the combustion gases. As the combustion gases cool the gaseous metals condense onto the surface of the small particles of fly ash present in the gas. These toxic substances may be transported from ash to the environment by air or water. Thus, management of these wastes must be conducted in a manner which minimizes airborne particulates to the extent possible.

Laboratory ash testing and analysis of field leachate have shown that while toxic metals are present in ash, they are found only at low levels or not at all in leachate from land disposal facilities which dispose of ash in ash-only cells (hereinafter referred to as ash monofills) (Appendix 3). Ash monofill leachate typically contains equal or lesser concentrations of toxic metals and greater concentrations of chloride, sodium, and sulfate than leachate from municipal solid waste land disposal facilities. Although chloride, sodium and sulfate are not considered toxic to humans, their presence at high levels in drinking water is undesirable. Also, adding these substances to fresh water surface waters must be avoided (References 1 and 2).

Assessment of the physical properties of waste combustor ash using particle size distribution analyses has shown the consistency of bottom ash to be similar to gravel, whereas combined ash includes finer material, with almost equal gravel and sand content (Reference 3). Fly ash alone is made up of fine particles. Fly ash collected by air pollution control equipment which includes an acid gas removal system ("scrubber") contains lime. Such ash has pozzuolanic properties similar to cement. Ash from mass burn waste combustors also typically contains pieces of metal, such as pipes, cans, etc. Ash from

combustors which burn RDF is generally much finer than mass burn ash, with a consistency similar to grey, sandy soil.

It should be noted that although these statements apply to municipal solid waste combustor ash in general, there are differences among ash generated by different waste combustors. The main causes of these differences are the design of the facility, especially the air pollution control equipment, and the characteristics of the waste burned.

3. History of Ash Regulation in Minnesota

a. Prior to 1988 waste combustor ash was regulated as an industrial waste, subject to the existing solid waste or hazardous waste rules, depending on the results of evaluation of the ash in accordance with Minn. Rules pts. 7045.0214 and 7045.0131.

b. In 1988, the Minnesota Legislature passed Minn. Stat. § 115A.97 which contains six subdivisions which apply to waste combustor ash (Appendix I). Subdivision 4 provides:

> (a) Incinerator ash is considered special waste for an interim period which expires on the occurrence of the earliest of the following events:
>
> 1) The EPA establishes testing and disposal requirements for incinerator ash;
> 2) The Agency adopts the rules required in subdivision 3; or
> 3) June 30, 1991.
>
> (b) As a special waste, incinerator ash must be stored separately from mixed municipal solid waste with adequate controls to protect the environment as provided in Agency permits. For the interim period, the Agency, in cooperation with generators of incinerator ash and other interested parties, shall establish a temporary program to test, monitor and store incinerator ash. The program must include separate testing of fly ash, bottom ash, and combined ash unless the Agency determines that because of physical constraints at the facility separate samples of fly ash and bottom ash cannot be reasonable obtained in which case only combined ash must be tested. Incinerator ash stored during the interim period is subject to the rules adopted pursuant to subdivision 3 and to the provisions of chapter 115B.

Minn. Stat. § 115A.97, subd. 4 (1990).

In 1988 and 1989 the Agency established and implemented the Temporary Management Program for Mixed Municipal Solid Waste Incinerator Ash (Temporary Program). The Temporary Program includes procedures for testing fly ash, bottom ash, and combined ash, and requirements for storage of waste combustor ash.

To establish the Temporary Program and final ash rules a task force was convened by the MPCA. The Municipal Solid Waste Incinerator Ash Rules Task Force (hereinafter "Task Force") consists of Agency staff, representatives of the regulated community (i.e., combustor owners or operators, including local officials), representatives of environmental groups, and other interested parties. The Agency adopted the Temporary Program storage requirements for municipal solid waste combustor ash in September 1988. Ash testing requirements were adopted to complete the Temporay Program in the spring of 1989.

The Temporary Program requires that municipal solid waste combustor ash be stored in lined facilities. As a result of compliance with the Temporary Program, ash from Minnesota's three oldest operating waste combustors is no longer disposed of in unlined land disposal facilities. Parts 17.0 and 18.0 of the Temporary Program contain design and operating requirements for Type I and Type II ash storage facilities, respectively. For a Type I ash storage facility, the ash must be stored over a liner and completely removed from the storage area when the facility is closed. Type II ash storage facility design requires that the ash be stored over a liner and leachate collection system similar to the system required for a municipal solid waste land disposal facility, using either a clay-only liner or a synthetic/clay composite liner. Minn. Rules pt. 7035.2915 of the proposed rules establishes special requirements which dictate future regulation of Type I and Type II ash storage facilities.

Also, under the Temporary Program, each owner or operator of a waste combustor has submitted quarterly ash monitoring data. These data have included total composition and leaching potential analysis of bottom, fly and combined ash. These data have been used for development of many parts of the rules.

c. The proposed rule amendments have been developed by the Agency over a period of approximately two and one-half years. Development has included several meetings with affected and interested parties through the Task Force.

Early meetings consisted of discussion of "position papers" regarding especially critical and often controversial subjects, including ash testing, classification of waste combustor ash as hazardous or nonhazardous, reduction of the toxicity and quantity of incinerator ash, the practice of managing bottom and fly ash as combined ash, and treatment and utilization of ash (Exhibit I). Appendix IV lists meeting dates and subjects of discussion. The Task Force and a number of committed persons (not official members) who also regularly attended Task Force meetings provided ideas and information to the Agency which have been used as a basis for many parts of the proposed rules.

B. LEGAL BACKGROUND OF WASTE COMBUSTOR ASH

1. Analysis of Federal Statute and Regulation

Ash from combustors which burn mixed municipal solid waste is excluded from regulation as a hazardous waste under federal law. Municipal solid waste combustor ash results from burning primarily household waste along with some commercial/industrial waste for the dual purpose of energy recovery and waste disposal. Since 1980, EPA regulations have included a provision excluding from "hazardous waste" the waste from a resource recovery facility managing municipal solid waste. 40 C.F.R. § 261.4(b) (1). Congress incorporated that exclusion into the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §§ 6901 et seq., with its 1984 Hazardous and Solid Waste Act amendments to RCRA, Pub. L. No. 98-616, tit. II, § 223 (codified as 42 U.S.C. § 6921(i)).

The amendment, entitled "Clarification of household waste exclusion," excludes from the hazardous waste regulation of RCRA ash from incinerators of refuse-derived fuel. The amendment provides that:

> a resource recovery facility recovering energy from mass burning of municipal solid waste shall not be deemed to be treating, storing, disposing of, or otherwise managing hazardous wastes for the purposes of regulation under this subtitle, if --
>
> (1) such facility --
>
> (A) receives and burns only --
>
> (i) household waste (from single and multiple dwellings, hotels, motels, and other residential sources), and

(ii) solid waste from commercial or industrial sources that does not contain hazardous waste identified or listed under this section, and

(B) does not accept hazardous wastes identified or listed under this section, and

(2) the owner or operator of such facility has established contractual requirements or other appropriate notification or inspection procedures to assure that hazardous wastes are not received at or burned in such facility.

42 U.S.C. § 6921 (i).

The amendment was accompanied by a report from the Senate Committee on Environment and Public Works. The report confirmed that the RCRA amendment was intended to exclude form hazardous waste regulation all activities of resource recovery incinerators:

> Resource recovery facilities often take in such "household wastes" mixed with other, non-hazardous waste streams from a variety of sources other than "households" including small commercial and industrial sources, school, hotels, municipal building, churches, etc. It is important to encourage commercially viable resource recovery facilities and to remove impediments that may hinder their development and operation.
> . . . All waste management activities of such a facility, including the generation, transportation, treatment, storage, and disposal of waste shall be covered by the exclusion, if the limitations in paragraphs (1) and (2) of subsection (d) (sic) are met.

S. Rep. No. 284, 98th Cong., 1st Sess. 61 (1983)

The Conference Committee adopted the Senate amendment without change and reported as follows: "[t]he Senate amendment clarifies that an energy recovery facility is exempt from hazardous waste requirements if it burns only residential and non-hazardous commercial wastes and establishes procedures to assure hazardous wastes will not be burned at the facility."
H. R. Conf. Rep. No. 1133, 98th Cong., 1st Sess. 106 (1984).

In 1985, the United States EPA adopted a regulation identical to 42 U.S.C. § 6921(i). 40 C.F.R. § 261.4(b) (1). The regulation implements the Senate

amendment excluding incinerator ash from hazardous waste regulation. The regulation first says that household waste is not hazardous waste. The remainder of the regulation is identical to the United States Code language quoted above. In May 1989, hearings were held on a proposal to classify energy recovery incinerator ash as a "special waste" under the solid waste provisions of RCRA.

42 U.S.C. § 6921(i), 40 C.F.R. § 261.4(b)(l) and the accompanying reports have been interpreted to mean that energy recovery incinerators are, in fact, exempt from hazardous waste generator requirements. Environmental Defense Fund, Inc. v. Chicago, 727 F. Supp. 419 (N.D. Ill., 1989), Environmental Defense Fund, Inc. v. Wheelabrator Technologies, Inc., 725 F. Supp. 758, (S.D. N.Y., 1989). In the second case, the Environmental Defense Fund (EDF) took the position that energy recovery incinerators are subject to hazardous waste generator regulations because incinerator ash fails the toxicity test for hazardous waste.

The court squarely rejected the argument, holding that the household waste exclusion in 42 U.S.C. § 6921(i) and 40 C.F.R. § 261.4(b) (l) includes ash from energy recovery incinerators. EDF v. Wheelabrator Technologies, Inc., 725 F. Supp. at 765, 766, 770. The court reasoned that while energy recovery incinerators were not specifically excluded from generator regulation under 42 E.S.C. § 6921(i), the section taken together with congressional reports, evinced a clear congressional intent to exclude the incinerators. Id.

The Congress has recently extended the exclusion identified in the two cases discussed above. In section 306 of the Clean Air Act Amendment of 1990, the Congress expressly directed the Administrator of the EPA not to regulate the "ash from solid waste incinerator units burning municipal waste" for a period of two years after the date of enactment of the Clean Air Act Amendment of 1990, referring directly to section 3001 of the Solid Waste Disposal Act, 42 U.S.C. § 6921, the provision containing the household waste ash exclusion.

2. Analysis of State Statute and Regulatory Program

Minnesota law specifically treats incinerator ash differently from hazardous or solid waste. The Minnesota Legislature in 1988 recognized that the United States EPA may yet regulate incinerator ash. As an interim measure, the Legislature classified incinerator ash as a "special waste" and authorized the

Agency to regulate it to achieve to the maximum extent feasible and prudent the reduction of the environmental impact of incinerator ash. Minn. Stat. § 115A.97 (1990). The statute authorizes establishment of a temporary program to test, monitor and store incinerator ash. Minn. Stat. § 115A.97, subd. 4(b) (1990). The Agency adopted the temporary program on September 27, 1988.

The statute also authorized the Agency to promulgate rules for testing, management, and disposal of incinerator ash. Minn. Stat. § 115A.97, subd. 3 (1990).

The Legislature's designation and regulation of incinerator ash as a "special waste" removes incinerator ash from regulation as a hazardous waste or as a solid waste during the interim period defined in Minn. Stat. § 115A.97. It is not possible to regulate the ash under more than one set of rules at a time due to the obvious potential for conflict between rules. Therefore, the Legislature's action means that Minn. Stat. § 115A.97 (1990), and the program and rules adopted under it, are the exclusive regulation of incinerator ash in Minnesota.

IV. NEED FOR THE PROPOSED RULES

Minn. Stat. § 14.14, subd. 2 (1990) requires an agency to make an affirmative presentation of the facts establishing the need for and the reasonableness of the proposed rules. In general terms, this means that an agency must set forth the reasons for proposing rules and the reasons must not be arbitrary or capricious. However, to the extent that need and reasonableness are separate, need has come to mean that a problem exists and requires administrative attention and reasonableness means that the solution proposed by the agency is a proper one. The Agency will first address need. Reasonableness is addressed in part V of this document.

The need for the proposed rule amendments arises from three sources:

1. The proposed rules are needed to fulfill the directives of Minn. Stat. § 115A.97, subd. 3, which states:

> The Agency shall adopt rules to establish techniques to measure the noncombustible fraction of mixed municipal solid waste prior to incineration or processing into refuse derived fuel and for at least the testing, management, and disposal of incinerator ash. The rules must be designed to meet the goals in subdivision 1.

Subdivision 1 of this statute states:

> It is the policy of the legislature that mixed municipal solid waste incinerators be planned and managed to achieve to the maximum extent feasible and prudent:
>
> 1) reduction of the toxicity of incinerator ash;
> 2) reduction of the quantity of incinerator ash; and
> 3) reduction of the quantity of waste processing residuals that require disposal.
>
> The purpose of this section is to establish temporary and permanent programs to achieve these goals.

2. The proposed amendments are needed to clarify the regulatory status of municipal solid waste combustor ash in Minnesota. As discussed in Part III, a certain degree of ambiguity has existed regarding the applicability of Minn. Rules ch. 7045, the hazardous waste rules, to ash which results from combustion of mixed municipal solid waste. Ash testing performed in Minnesota and in other states for use in classifying waste combustor ash as hazardous or nonhazardous frequently produced results which average near the hazardous waste toxicity limits for lead and/or cadmium, so that it has not been clear whether ash needed to be classified as a hazardous waste.

3. The proposed amendments are also needed from an environmental protection and overall waste management point of view. In particular, the need to apply Minn. Rules ch. 7045 to waste combustor ash has been questioned, as has the adequacy of Minn. Rules ch. 7035 to provide environmental protection.

The environmental concerns relating to waste combustor ash and the feasibility of properly managing the ash are summarized in Reference 4. The authors, a group of international experts in the field of waste combustion, concluded that "all ash residue from incineration of municipal solid waste can be presently (N.B. not to be confused with the statement 'always ... <u>is being</u> ') managed in a manner which is safe from the point of view of protection of human health or the environment." The report goes on to say, "There are, however, constituents of concern in ash residue such as chloride- and sulfide-based salts which have properties akin to dilute sea water, i.e., they can be corrosive and could be harmful to any fresh water into which they might obtain access, for example, if transported in leachate. Metals such as lead, cadmium, zinc and mercury may also be present and of concern because of their potential leaching from ash residue."

A set of rules is needed which provides adequate environmental protection for activities relating to waste combustor ash, including land disposal and storage, without being unnecessarily burdensome.

V. REASONABLENESS OF THE PROPOSED RULES

The Agency is required to make an affirmative presentation of facts establishing the reasonableness of the proposed rules. Minn. Stat. § 14.14, subd. 2 (1990). Reasonableness is the opposite of arbitrariness and capriciousness and means that there is a rational basis for the Agency's proposed action. The purpose of this section is to demonstrate that each provision is a reasonable approach to its defined function.

The discussion below addresses the reasonableness of the provisions of the proposed rule amendments.

Reasonableness of the Proposed Amendments as a Whole.

A. MANAGEMENT OF ASH AS A SOLID WASTE

It is reasonable to manage ash as a nonhazardous solid waste. The basis for this conclusion is presented in an Agency position paper (Appendix V).

B. DIVISION OF RULE INTO PARTS

The proposed rules relating to waste combustor ash are divided into parts. The division into these parts is reasonable because each part addresses a separate activity, and each part may apply to different parties.

C. REDUCTION OF ASH TOXICITY AND THE QUANTITY OF ASH AND WASTE PROCESSING RESIDUALS

Minn. Stat. § 115A.97, subds. 1 and 3 requires that the Agency adopt rules for testing combustor ash for the purposes of evaluating the noncombustible fraction, reducing the toxicity of incinerator ash, reducing the quantity of incinerator ash, and reducing the quantity of waste processing residuals that require disposal. Proposed Minn. Rules parts 7035.2885 and 7035.2910, in

conjunction with the requirements of proposed Air Quality Division waste combustor rules, are intended to accomplish these goals (Appendix VI).

The establishment of land disposal facility design requirements based on ash toxicity, as discussed below regarding part 7035.2885, subpart 11, encourages reduction of the toxicity of waste combustor ash. Minimum design standards for ash which leaches below given limits are less strict than standards which apply to ash which exceeds the standards. Therefore, costs of actions taken to reduce ash toxicity, such as hiring extra staff to survey waste as it is received and remove undesirable materials, may be offset by savings in the area of land disposal facility construction.

Data required under proposed waste combustor rules part 7005.0695 regarding the amount of waste burned and the amount of ash and process residuals produced, will be compared from year to year to see if quantities of ash and processing residuals are reduced. Information required by Minn. Rules pt. 7035.2875 as part of refuse-derived fuel processing facility annual reports will also be used to track reduction in quantity of processing residuals discarded by such facilities. Data submitted with annual reports required by Minn. Rules pt. 7035.2910 will be used to assess reductions in ash toxicity achieved. The Agency intends to report progress in meeting these goals to the legislature every two years as part of the solid waste policy report.

Rules regarding reduction of ash toxicity and the quantity of ash and process residuals produced have been divided between proposed ash and air quality rules for a number of reasons. First, subdivision 6 of Minn. Stat. § 115A.97 requires that an application for a permit to build and operate a mixed municipal solid waste combustor, including a permit renewal application, clearly states how the applicant will meet the goals of subdivision 1 regarding reducing ash toxicity and the quantity of ash and processing residuals. Because such permit applications are regulated through Minn. Rules ch. 7005, air quality rules, it is reasonable to include these requirements in that chapter. Second, air quality rules and permits regulate operation of waste combustors. Although the goals of subdivision 1 relate to ash, the actions that are to be taken to meet the goals relate to waste combustor operation, including controlling waste received. Therefore, it is reasonable to emphasize in air quality rules the need to operate a waste combustor in a manner which reduces ash toxicity and the quantity of ash and waste processing residuals.

To assess reductions in the quantity of ash produced, the ratio of ash to waste burned will be used. For example, a ratio of ash to waste of 1:5 is an improvement over a ratio of 1:4. This indicates that less noncombustible waste is going through waste combustors. Therefore, this comparison will also be used as the measure of noncombustibles, to satisfy the requirements of subpart 3 of Minn. Stat. § 115A.97. In calculating this ratio, the amount of excess lime contained in ash as a result of the dry scrubbers will be subtracted from the amount of ash produced.

Putting noncombustible waste through a waste combustor is undesirable because:

1. Many noncombustibles, such as glass, metal, and concrete are recyclable;

2. There is no energy production or other environmental benefit to burning noncombustibles other than burning the combustible fraction, such as plastic, or cardboard, off of composite items (i.e., something made up of more than one material), which may render the remaining metal more recyclable. In fact, noncombustibles can reduce energy production because they absorb heat; and

3. Noncombustibles may release metals or other contaminants when they are heated.

This approach to meeting the legislative goals regarding reducing the quantity and toxicity of waste combustor ash is reasonable because it establishes a program which requires planning (as part of waste combustor permit applications), and monitoring (ash testing and quantity reporting). In addition, an incentive system is established which increases the potential for compliance with this goal by decreasing the burden of other rule requirements, without compromising environmental protection.

Reasonableness of Individual Parts

In this section the Agency presents facts in support of each subpart of the proposed rules. The degree of detail provided depends on the extent of the

burden a particular requirement places on the regulated parties, and the amount of controversy surrounding a particular requirement.

A. Reasonableness of Proposed Amendments to Minn. Rules ch. 7001 MINNESOTA POLLUTION CONTROL Agency PERMITS

A number of amendments to Minn. Rules ch. 7001 are proposed. The proposed amendments include a small number of substantial additions and numerous minor changes to existing parts of Minn. Rules ch. 7001, and one all-new part.

1. Minn. Rules pts. 7001.0040: APPLICATION DEADLINES, 7001.3075 SOLID WASTE MANAGEMENT FACILITY PERMIT APPLICATION, and 7001.3275 DETAILED SITE EVALUATION REPORT

Minn. Rules Pts. 7001.0040, subpart 4, 7001.3075, subparts 1 and 2, and 7001.3275, subparts 1 and 3, have been amended to apply to municipal solid waste combustor ash land disposal facilities certain requirements regarding submittal of preliminary applications and detailed site evaluation reports. These requirements currently only apply to mixed municipal solid waste land disposal facilities. Submittal of a preliminary application allows the Agency the opportunity to comment on the proposed site before extensive time and money are spent completing the hydrogeologic research and design work needed for a detailed site evaluation report. This improves the likelihood that the final site selected by the proposer will be acceptable to the Agency. Because the location requirements for municipal solid waste combustor ash land disposal facilities are identical to mixed municipal solid waste land disposal facilities, and the design requirements are very similar, it is reasonable to apply these requirements to municipal solid waste combustor ash land disposal facilities also. Therefore, references to Minn. Rules pt. 7035.2815 in these subparts have been changed to Minn. Rules pt. 7001.2885 to include municipal solid waste combustor ash land disposal facilities.

2. Minn. Rules Pt. 7001.3300: GENERAL INFORMATION REQUIREMENTS FOR FINAL APPLICATION

Minn. Rules pt. 7001.3300, item B, has been amended to require that the owner or operator of a municipal solid waste combustor ash land disposal

facility submit, as part of the permit application, an explanation of how they will ensure that no industrial wastes, or only those which have been approved by the commissioner, are disposed of at the facility, as provided by Minn. Rules pt. 7035.2885, subpart 3. Because co-disposal of unapproved wastes may increase the leaching potential of ash, thus increasing the potential for ground water contamination, it is reasonable to require that an applicant explain how they will avoid this occurrence. The operator must also plan how they will physically manage non-ash wastes which may need different handling or covering methods. Compliance with this requirement may be met by describing an inspection process for haulers delivering wastes to the facility, operator training, and other activities which will prevent unauthorized co-disposal.

Minn. Rules pt. 7001.3300, items E, O and Q, have been amended to extend the submittal requirements for contingency action plans, locational information, and plans for construction inspection, quality control and quality assurance to reflect the requirements of new Minn. Rules pt. 7035.2885.

3. Minn. Rules pt. 7001.3480: FINAL APPLICATION INFORMATION REQUIREMENTS FOR MUNICIPAL SOLID WASTE COMBUSTOR ASH LAND DISPOSAL FACILITIES

Minn. Rules pt. 7001.3480 presents final application requirements for municipal solid waste combustor ash land disposal facilities (all new requirements). This part is similar in many ways to the requirements applicable to municipal solid waste land disposal facility set out in Minn. Rules pt. 7001.3475. Requirements of Minn. Rules pt. 7001.3475 which do not apply to municipal solid waste combustor ash have been omitted, including requirements regarding certification of need. The certificate of need process helps to assure that land disposal of municipal solid waste is used as the last choice management method by only allowing the Agency to permit disposal capacity which the entity which is responsible for local solid waste planning can prove is needed. Although there has been discussion of extending the certificate of need process to municipal solid waste combustors, once such a facility becomes operational it is necessary to have ash disposal capacity. Alternatives to land disposal of ash such as utilization are not well enough established at this time to warrant requiring that they be considered before approval is given for land disposal. Therefore it is reasonable to exclude this requirement from the

municipal solid waste combustor ash land disposal facility permit application requirements.

In addition to complying with the requirements of Minn. Rules pt. 7001.3480, a permit application for a municipal solid waste combustor ash land disposal facility must also comply with existing Minn. Rules pt. 7001.3300 "General Information Requirements For Final Application." Minn. Rules pt. 7001.3300 applies to all solid waste management facility permit applications.

Item A. It is necessary for the Agency to know the chemical and physical characteristics of a waste when reviewing plans to determine whether the proposed design of the facility such as liner efficiency, operating procedures, and cover frequency will be adequate. Identifying the source of ash allows the Agency to determine whether the proposed municipal solid waste combustor ash land disposal facility is identified in the waste combustor's Agency-approved ash management plan. Also, if the Agency has data from testing actual leachate or from laboratory leach tests which pertain to the ash from the identified source or sources it would be prudent for the Agency to consider such data when reviewing the proposed facility.

Item B. The capacity of the proposed site is used by the Agency in a number of ways. First, the expected capacity of the site is compared to the capacity calculated based on the facility design by the Agency staff person reviewing the plans. If the two numbers are not substantially the same, it may indicate a design or plan-drafting error. The design filling rate is used to determine how long each cell will be open. This assists Agency staff in determining compliance with Minn. Rules pt. 7035.2885, subpart 9, through reference to Minn. Rules pt. 7035.2815, subpart 5, item B, which requires that land disposal facilities consist of cells which will provide for filling in a manner to achieve final waste elevation as rapidly as possible. Secondly, the capacity of a proposed site is typically identified in the facility draft permit public notice. Experience shows that the public wants to know the size of a proposed waste management facility.

Item C. This item requires that the application include a description of how the requirements of Minn. Rules pt. 7035.2885, subparts 4 and 5, regarding maximum leachable contaminant levels will be met. This requirement may be satisfied by showing that the owner or operator has made arrangements to receive

results of testing required by Minn. Rules pt. 7035.2910 and has set out a framework for reviewing those results and notifying the Agency if the results approach or exceed the maximum leachable contaminant levels. Plans for taking actions to decrease ash leachable contaminant levels within a reasonable period of time or for taking alternative steps to come into compliance with the 7035.2885, subpart 4, must also be identified. It is reasonable to require that an applicant demonstrate that they are prepared to meet all requirements of Minn. Rules pt. 7035.2885. If they are not, a permit should not be issued.

The owner or operator of a land disposal facility for ash from an existing municipal solid waste combustor will be able to review existing leach test data to determine whether their facility will likely comply with Minn. Rules pt. 7035.2885, subpart 4, without making modifications to the waste, ash or facility design. However, existing facilities must plan ahead how they will react if the waste combustor makes changes in design or operation which cause the maximum leachable contaminant levels to be exceeded. Land disposal facilities which will accept ash from new waste combustors must determine whether it is likely that ash from a new waste combustor will exceed the maximum leachable contaminant levels. In accordance with part 7035.2885, subp. 4, item E, if there is no basis, such as data from a similar existing waste combustor, for believing that ash will not exceed the maximum leachable contaminant levels, the land disposal facility must be constructed to meet the requirements of Minn. Rules pt. 7035.2815, subparts 10 and 11, or the waste combustor must be prepared to immediately implement waste modification or ash treatment methods so that ash produced by the waste combustor and disposed of at the land disposal facility does not exceed the maximum leachable contaminant levels.

Item D helps Agency staff develop a schedule for the complete review process. Establishing such a schedule is also useful for the permit applicant so that they can coordinate permitting activities for which they are responsible. This also ensures that an applicant is aware of the requirements of the Environmental Quality Board rules which apply to municipal solid waste combustor ash land disposal facilities. These include Minn. Rules pt. 4410.4300, subpart 17, item G, which lists municipal solid waste combustor ash land disposal facilities in the category of mandatory environmental assessment worksheet (EAW) facilities.

The remainder of the items of this subpart are identical to requirements of Minn. Rules pt. 7001.3475. The reasonableness established in the Solid Waste Statement of Need and Reasonableness (SONAR) on pages 82 to 84 applies equally well to land disposal of municipal solid waste combustor ash (Appendix VII).

B. Reasonableness of Proposed Amendments to Minn. Rules pt. 7035.0300: DEFINITIONS

Subpart 1. Scope. This subpart has been changed so that the definitions of this part apply to the new parts of this chapter: 7035.2885, 7035.2910, and 7035.2915.

Subpart 5. The term "incinerated" has been replaced by "combusted" for consistency with the rest of the chapter. "Incinerator ash", "waste combustor residues" and "waste to energy residues" are other terms which are often used to refer to waste combustor ash. The Agency has chosen to use the term "waste combustor" for consistency with proposed air quality rule amendments, and to use the term "ash" rather than "residues" because of its simplicity.

Subpart 7a. Bottom ash. Parts 7035.2885 and 7035.2910 include requirements for testing and disposal of bottom ash, fly ash and combined ash. Therefore it is necessary to define these terms. There are a number of different terms which are used by industry and other regulatory agencies to refer to fly ash and bottom ash. The Agency has chosen to use the terms bottom ash and fly ash because they seem to be commonly understood and they are also shorter and simpler than other terms. In addition to referring to a type of solid waste waste combustor ash, bottom ash is also frequently used to refer to a type of coal ash. Therefore, this definition of bottom ash is not specific to waste combustor ash.

A small portion of the ash generated at a waste combustor is carried out of the combustion chamber with the flow of gases and collected by boiler tubes, economizers, and other equipment before the gases reach air pollution control equipment, which is designed specifically to remove ash from the gases before they exit the facility. In the case of a fluidized bed waste combustor, such as at Western Lake Superior Sanitary District (WLSSD), virtually all ash is carried out of the combustion chamber with the flow of gases. A large portion of the ash at a fluidized bed waste combustor is captured before gases reach the air

pollution control equipment. As illustrated by Figure 1, ash collected by such equipment may be directed toward the fly ash conveying system or the bottom ash conveying system, depending on the design of the facility. This definition clarifies that this ash may be considered fly ash or bottom ash, depending on the design of the waste combustor. The decision is left up to the owner or operator.

With the exception of fluidized bed waste combustors, ash collected by boiler tubes, etc., comprises a relatively small percentage of the ash produced at a waste combustor. For example, at the Olmsted-Dodge waste combustor, ash from boiler tubes and the economizer is directed into the fly ash conveying system. Approximately ten percent of the total amount of ash produced is fly ash. Approximately ten percent of the fly ash, or one percent of the total amount of ash produced is ash from boiler tubes and the economizer. The level of contaminants contained in this ash is generally less than fly ash and greater than bottom ash (Reference 5, Appendix XI).

To avoid increasing the level of contaminants contained in bottom ash, Agency staff considered requiring that boiler and economizer ash be managed along with fly ash. However, because the quantity of boiler and economizer ash is so small, mixing this ash with bottom ash is not expected to have a major impact on the quality of bottom ash. In the case where a waste combustor owner or operator manages combined bottom ash and fly ash, it is irrelevant how boiler and economizer ash are classified. If a waste combustor elects to separately manage bottom ash and fly ash, they may manage boiler and economizer ash as part of the fly ash stream if necessary to meet the maximum leachable contaminant levels or exemption requirements. Because compliance with these standards will dictate whether it is necessary to keep bottom ash separate from boiler or economizer ash, it is not necessary that these rules require management of boiler and economizer ash as fly ash.

Subpart 15a. Combined ash. This term is commonly used by persons familiar with waste combustors to describe a mixture of bottom and fly ash. Ising this term in the rules makes them more concise.

Subpart 35. Energy recovery facility. The word "site" has been changed to facility for clarity and precision. A sentence stating that a municipal solid waste combustor is a type of energy recovery facility has been added to alert owners and operators of municipal solid waste combustors that requirements that

apply to energy recovery facilities, such as the permit-by-rule provisions in Minn. Rules pt. 7001.3050, subpart 3, item E, also apply to them.

Subpart 38a. Fly ash. Parts 7035.2885 and 7035.2910 include requirements for testing and disposal of bottom ash, fly ash and combined ash. Therefore it is necessary to define these terms. Fly ash is also known as "air pollution control equipment residues," and "top ash," but the term "fly ash" is generally understood. Any combustion facility process which collects particulates using air pollution control equipment, such as burning of coal or fuel oil, produces fly ash. The definition also clarifies that ash carried out of the combustion chamber which is collected by boiler tubes, an economizer, or other equipment other than air pollution control equipment may be considered fly ash or bottom ash, depending on the design of the waste combustor. (See discussion above regarding bottom ash).

Subpart 49. Intermittent cover. This definition has been modified to fit the intent of the proposed rules for waste combustor ash land disposal facilities as well as the existing solid waste rules. Under the proposed rules weekly cover over ash is not required. The intent of intermittent cover at a waste combustor ash land disposal facility, in addition to the functions listed in existing the definition, is to minimize the formation of dust. Therefore it is reasonable to clearly state this in the definition of intermittent cover.

Subpart 62a. Maximum leachable contaminant levels. This term is defined because it is a new term which has not been used previously in solid waste rules. The definition specifies that it only applies to municipal solid waste combustor ash. The term includes the word "leachable" to emphasize that the standards only apply to the amount of pollutants which leach out of ash. The total composition of pollutants is not relevant to determining compliance with these standards. Some persons have commented that use of "maximum" in the definition is misleading, because ash which exceeds the standards may still be disposed of in a land disposal facility which complies with more strict design standards. However, the maximum leachable contaminant levels define the point where ash may no longer be disposed of in what Agency staff believes will be the most common, standard land disposal facility design. The Agency encourages waste combustors to take actions as necessary, including removal of certain items from the waste stream and/or ash treatment, to avoid exceeding these

levels. For these reasons Agency staff believes naming the standards "maximum leachable contaminant levels" is appropriate and reasonable.

Subpart 67a. Municipal solid waste combustor ash. This definition is necessary because Minn. Rules pts. 7035.2885 to 7035.2915 apply to municipal solid waste combustor ash (combustor ash). It is necessary to specify "municipal solid waste" because there are other types of waste combustors, such as wood waste or waste oil combustors, which produce ash with different physical and chemical properties which is not subject to the same regulations as municipal solid waste combustor ash. "Incinerator ash," "waste combustor residues," and "waste to energy residues" are other terms which are often used to refer to waste combustor ash. The Agency has chosen to use the term "waste combustor" for consistency with air quality rules, and to use the term "ash" rather than "residues" because of its simplicity.

It is the Agency's intent to regulate large municipal solid waste combustors under Minn. Rules pts. 7035.2885 to 7035.2915, although no size limit is given in the rules. Therefore, any waste combustor, regardless of size, which burns mixed municipal solid waste is subject to these rules. Mixed municipal solid waste means solid waste from household and commercial establishments collected in aggregate. Therefore, small apartment, grocery store, etc., incinerators which burn waste before it leaves the point of generation are not subject to Minn. Rules pts. 7035.2885 to 7035.2915. Currently, Agency staff is aware of the existence of only twelve waste combustors which meet this definition (Appendix VIII). The need and reasonableness of these rules is based on those twelve facilities.

A minimum waste combustor size below which a facility is not subject to these rules is not specified. Although some requirements of these rules would be a significant burden for very small waste combustors, exempting small waste combustors from the requirements of these rules is not justified because there is no practical need for small facilities to exist. Modern solid waste management practices are based on use of relatively large, centralized waste processing facilities. It is left up to the proposer of a new mixed municipal solid waste combustor to determine whether the proposed facility will be large enough support the cost of compliance with the requirements of Minn. Rules pts. 7035.2885 to 7035.2915. Economy of scale is also a very important consideration for compliance with the draft air quality waste combustor rules.

This definition also clarifies when ash from co-combustion of municipal solid waste with other wastes or fuels is to be considered municipal solid waste combustor ash subject to Minn. Rules pts. 7035.2885 to 7035.2915. It is not uncommon for a hospital to burn its noninfectious solid waste along with its infectious waste. The Agency wants to discourage this practice, as it may decrease the incentive for the facility to manage its solid wastes through other methods which are preferable to incineration such as waste reduction and recycling. It should be noted, however, that infectious wastes alone consist of a large percentage of plastic materials, which burn very quickly, and noncombustible glass or metal items. Burning a certain amount of other wastes such as municipal solid waste with infectious waste in some cases may create more consistent, complete combustion, which is needed to achieve thorough destruction of infectious agents and to reduce potential for formation of dioxins. Also, if a hospital burns only waste generated on its premises, not mixed municipal solid waste, (i.e., collected in aggregate from households and commercial establishments) the municipal solid waste combustor ash rules do not apply. The combustor ash rules only apply to a medical waste combustor which incinerates large amounts (more than 20 percent of its heat input) of mixed municipal solid waste from outside the premises.

Co-combustion of refuse derived fuel (RDF) with fossil fuel is a practice which at least two companies in Minnesota are pursuing. While the Agency does not prohibit the practice of co-combusting fossil fuel and RDF, Agency staff believes that the resulting ash must be managed in an environmentally sound manner based on its characteristics. The proposed rules refer to state and federal rules and statutes which dictate when a facility which co-combusts RDF and fossil fuels is considered a waste combustor. Currently 1989 Minn. Rules ch. 325 § 71 provides that a facility which burns 25 percent or more RDF is a waste combustor. However, this law expires on June 30, 1991. The federal Clean Air Act Amendments enacted in November of 1990 provide that an incineration unit shall not be considered subject to waste combustor standards if it combusts a fuel feed stream which is comprised, in aggregate, of 30 percent or less by weight municipal waste. Minnesota's draft waste combustor rules are more stringent than this: a facility where municipal waste makes up ten percent or more of the heat input rate of the facility would be subject to regulation as a waste combustor.

Agency staff believes it is reasonable to correlate the requirements of the ash rules and air quality waste combustor rules, so that a co-combustion facility is either subject to both air and ash rules relating to waste combustors, which have been coordinated to work together, or the facility is subject to neither ash nor air rules.

Some may believe this requirement is too strict because the ash from co-combustion should contain lower levels of toxic contaminants since it will be "diluted" by coal ash, which in general contains fewer toxic contaminants. However, the exemption standards of Minn. Rules pt. 7035.2885, subpart 2, would allow the ash, if it actually is very low in contaminants, to be exempt from the more strict standards of Minn. Rules pt. 7035.2885. The ash would still be subject to the testing requirements of Minn. Rules pt. 7035.2910, which are designed to determine if the level of contaminants in ash decreases as required by Minn. Stat. § 115A.97.

Finally, defining a limit of how much waste can be co-combusted with other wastes or fuels prevents using co-combustion as a means to avoid the requirements of these rules.

Subpart 67b. Municipal solid waste combustor ash land disposal facility. This term is frequently used and therefore warrants definition.

Subpart 89. Refuse. This definition has been amended to include waste combustor ash in addition to incinerator ash and incinerator residues. The existing definition most likely was originally intended to include waste combustor ash, because the term "incinerator" in the past was commonly used to refer to a municipal solid waste combustor. In light of the terminology conventions used by these rules, it is reasonable to add "waste combustor ash" to this definition to ensure that it continues to have its intended meaning.

Subpart 111a. Treatment. This term needs definition because it is used in the proposed rules with a specific meaning. Defining treatment as changing a waste for the purpose of reducing or controlling pollution or the release of contaminants into the environment eliminates other possible meanings of the word, such as treatment which changes properties of the waste like odor or appearance without decreasing its potential to pollute.

Subpart 115a. Waste Combustor. This term is defined because it is frequently used in the rules. The definition clarifies that incinerators are a type of waste combustor. This definition is also proposed to be included in the

Agency's Air Quality Division's waste combustor rules. It is reasonable to use an identical definition to avoid confusion in using a term which relates to many programs.

C. Reasonableness of Proposed General Amendments to Minn. Rules Ch. 7035: SOLID WASTE

There are a number of existing parts which have been amended simply to extend the applicability of those parts to proposed Minn. Rules pts 7035.2885 to 7035.2915. These include:

7035.2525 Solid Waste Management Facilities Governed
7035.2535 General Solid Waste Management Facility Requirements
7035.2545 Personnel Training
7035.2585 Annual Report
7035.2625 Closure
7035.2635 Closure Procedures
7035.2645 Postclosure Care
7035.2655 Postclosure Care and Use of Property
7035.2665 Financial Assurance Requirements

Parts which have been changed substantially are discussed below.

1. Minn. Rules pt. 7035.0605: AVAILABILITY OF REFERENCES.

Four new documents are incorporated by reference in this part. The documents contain specifications with which owners and operaters must comply. Because the specifications do not affect the overall meaning of the rules, incorporating them by reference makes the rules more consise without compromising their availability to the general public.

2. Minn. Rules pt. 7035.0700: STORAGE OF SOLID WASTE AT INDIVIDUAL PROPERTIES.

Subparts 1 to 5 have not been changed. Subpart 6 has been added to include specific requirements for storage of municipal solid waste combustor ash.

Municipal solid waste combustor ash has physical characteristics which warrant special regulations. When the ash is first produced, it typically contains a lot of water which it has absorbed in the quench tank used to cool ash. If the water content is more than the ash can hold, free liquids will drain from the ash. This liquid contains soluble contaminants from ash. Such contaminated liquids must be collected rather than allowed to escape into the general environment, e.g., through storm sewer drains which empty directly into a surface water body.

With time moisture leaves the ash through drainage and evaporation. Although ash typically forms a hard crust on the surface as it dries, dry ash, especially if it is agitated, may release dust. For this reason, this subpart requires that ash be stored in a manner which minimizes emission of dust. Actions which may be taken to comply with this part include avoiding storage of ash on the premises for any time period longer than is necessary to fill a truck (this is the current common practice at Minnesota municipal solid waste combustors), covering ash to minimize evaporation and exposure to moving air, and adding moisture to the ash if necessary.

The need to control dust emissions is also the basis for limiting the length of time ash can be stored at a waste combustor. Over 15 days a large percentage of the moisture present in ash will evaporate (Appendix IX). Although the owner or operator may take the steps identified above to minimize dust formation, there is usually no need to store ash at the waste combustor for more than a few hours, or a day at the most. An example of an occurrence which may necessitate storing ash for more than two days is where the supplier of transport for the ash is unavailable due to mechanical problems, strikes, etc. In this case a few days may be necessary to secure use of a new transportation means. If this cannot be done within a few days, the facility should cease operation until it has a means to remove ash from the site. A facility may avoid this situation by planning alternatives for ash transport and management.

3. Minn. Rules pt. 7035.2535: GENERAL SOLID WASTE MANAGEMENT FACILITY REQUIREMENTS

Minn. Rules pt. 7035.2535, subpart 5 regarding management of industrial waste at solid waste management facilities has been amended to exempt municipal

solid waste combustor ash land disposal facility from the requirements of items B and C. Because Minn. Rules pt. 7035.2885, subpart 3 does not allow co-disposal of wastes other than municipal solid waste combustor ash and other wastes specifically approved by the Commissioner in a combustor ash land disposal facility, items relating to other wastes do not apply to municipal solid waste combustor ash land disposal facilities.

4. Minn. Rules pts. 7035.2555: LOCATION STANDARDS and 7035.2635 CLOSURE PROCEDURES

Minn. Rules pt. 7035.2555 subpart 2, item A has been amended to make it more correct; Minn. Rules ch. 6120 applies to wild and scenic areas, Minn. Rules ch. 6105 to shore lands.

The proposed amendment to Minn. Rules pt. 7035.2635 deletes the requirement that as-built plans be attached to the deed which is submitted to the county recorder. It has been pointed out that this is virtually impossible to comply with, since county recorders do not have a filing system capable of storing complete plan sets. The Agency believes that the purpose of this part is not reduced by this deletion. As-built plans will be on file at the Agency and may be obtained as necessary through the Agency.

D. Reasonableness of All-New Minn. Rules pt. 7035.2885: MUNICIPAL SOLID WASTE COMBUSTOR ASH LAND DISPOSAL FACILITIES

This part sets forth requirements related to disposal of municipal solid waste combustor ash in or on the land. The minimum design and monitoring standards given in subparts 6 to 18 for waste combustor ash land disposal facilities are similar to municipal solid waste land disposal standards (Minn. Rules pt. 7035.2815) in format and in much of the content. Subparts 1 to 5 are all new material. Subpart 1 defines the scope of this part, subpart 2 contains standards for exemption from the requirements of this part, subpart 3 specifies what wastes may be accepted at a waste combustor ash land disposal facility, and subpart 4 requires that ash which exceeds the maximum leachable contaminant levels specified in subpart 5 be treated to reduce leachability prior to disposal or that the disposal facility design meet more stringent design requirements.

Land disposal facility rules specific to waste combustor ash have been written because waste combustor ash has unique physical and chemical characteristics which differ from mixed municipal solid waste. The intent of these rules is to require that waste combustor ash land disposal facilities be designed and managed to make optimum use of these characteristics and other design features to minimize the potential for environmental damage. Although there are other categories of wastes which also have unique characteristics, the large quantity of waste combustor ash which is generated in Minnesota each year, approximately 275,000 tons (roughly seven percent of total municipal solid waste production), justifies separate regulation of this waste.

Disposing of ash in ash-only land disposal facilities reduces the potential for contamination because the amount of metals which leach from the ash is reduced. Waste combustor ash often contains high concentrations of a number of heavy metals such as lead and cadmium which are considered environmental pollutants. The potential for these metals to leach from the ash is known to be related to the pH of the environment to which ash is exposed. Metals such as lead and cadmium leach from wastes more easily at acidic pHs; lead also leaches more easily at very high, alkaline pH. See Figure 2. Leachate produced in a mixed municipal solid waste land disposal facility typically is acidic, due to the decomposition of putrescible wastes. On the other hand, waste combustor ash is typically alkaline. Therefore disposing of ash by itself in a monofill or only with other similarly alkaline wastes decreases the potential for lead and cadmium to leach from ash.

This phenomenon can be seen by comparing the results of different laboratory leach tests. Analysis of waste combustor ash using leach tests such as the EP toxicity test or the Toxicity Characteristic Leaching Procedure (TCLP), which use acidic extraction fluid, often produces results which show high levels of lead and/or cadmium leaching from the ash (Appendix XIII and Attachment 2 to Appendix V). Ash tested using the water leach test or EPA Method 1312 (Appendix X), which only uses relatively little acid, in most cases does not show nearly as much of these metals leaching from the ash (Appendices I and XI). An exception to this has been testing of ash from waste combustors which are equipped with dry scrubbers which leave excess lime in the ash. Some air pollution control equipment uses excess lime to meet stringent sulfur dioxide emission limits. The lime may cause the pH during laboratory extractions to rise to very alkaline levels where lead is again more leachable. However, in

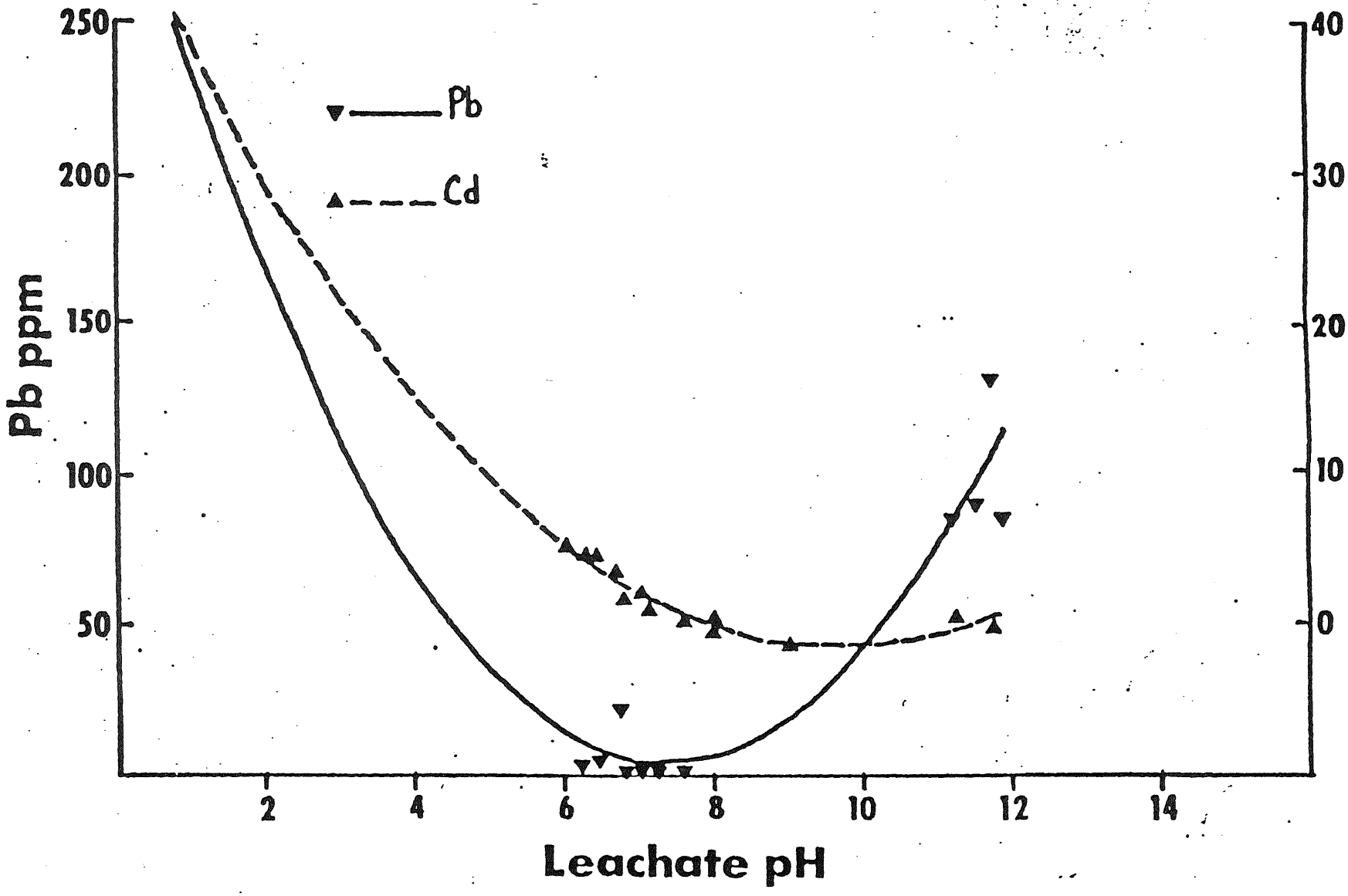


FIGURE 2: CONCENTRATIONS OF LEAD (Pb) AND CADMIUM (Cd) IN FLY ASH LEACHATES AS A FUNCTION OF LEACHATE PH. SOURCE: MIKA AND FEDER, 1985

the field, the pH of actual ash leachate from monofills containing ash from waste combustor which use dry scrubbers has been found to be between 7 and 8 (Reference 10), so monofilling ash from such facilities does not necessarily produce the highly alkline conditions where lead is more easily released.

Ash tested in accordance with Minn. Rules pt. 7035.2910 and managed in accordance with this part (or in the future, under Minn. Rules pt. 7035.2900: utilization requirements) is exempt from regulation under Minn. Rules ch. 7045, the hazardous waste rules, regardless of the hazardous waste characterization results. This is made clear in the definition of municipal solid waste combustor ash in proposed rule Minn. Rules pt. 7035.0300, subpart 67a. Based on evidence that monofilled ash does not leach high levels of metals or other toxic pollutants, staff believes disposal of municipal solid waste combustor ash in land disposal facilities designed and operated in accordance with this part adequately protects human health and the environment. The requirements of subparts 4 and 5, regarding maximum leachable contaminant levels, ensure that ash disposal facilities will not threaten human health or the environment by establishing more strict design requirements for ash which leaches above 15 times the Recommended Allowable Limits for Drinking Water. The more strict design requirements are the same as the Agency's rule requirements for hazardous waste disposal facilities. A land disposal facility which accepts ash which leaches above the hazardous waste limits must comply with design standards which the same as those specified by EPA guidance as minimum technology requirements for hazardous waste disposal facilities.

1. Subpart 1. Scope.

This subpart establishes the responsibility of all landowners and facility owners or operators of waste combustor ash land disposal facilities to comply with the requirements of this part. This subpart also clarifies that these requirements do not apply to owners or operators of land disposal facilities which do not accept municipal solid waste combustor ash.

2. Subpart 2. Exemptions.

This subpart exempts waste combustor ash which contains no or only low levels of contaminants from meeting the requirement of this part that waste combustor ash be disposed of in monofills meeting strict design standards. Ash

management policy in Minnesota has required storage and disposal of waste combustor ash separate from other wastes to reduce the contaminant leaching potential, as noted above. However, if contaminants are not present in significant quantities, it is not necessary to require separate ash management. The TCLP test is required in addition to Method 1312 to assess the impact of codisposal on ash, unless it is demonstrated that ash will not be exposed to an acidic environment.

An exemption such as this also serves as an incentive or reward for reducing ash toxicity. Such toxicity reduction could be achieved either through removal of certain products from the waste stream before combustion or through post combustion ash treatment.

The need for this exemption has been pointed out by two waste combustor permittees (Exhibits II and III).

Item A requires that the land disposal facility where ash is co-disposed be designed in compliance with Minn. Rules pt. 7035.2815, which requires that a facility design include a liner and leachate collection system, as well as a final cover which includes a barrier layer. This requirement is reasonable because exempt ash is allowed to contain a low level of contaminants based on the assumption that the receiving facility is lined to protect ground water.

Item B lists the criteria which results of ash testing must meet for the ash to be exempt from this part. Subitem (1) limits the dioxin content of the ash to 1 ug/kg (part per billion). Although dioxins and furans are not soluble in water, and therefore are not expected to leach out of ash placed in an ash monofill, these compounds are soluble if exposed to certain organic fluids. For example, laboratory methods used for dioxin analyses like EPA SW-846 Method 8280 use toluene to extract dioxins from the material being tested (Reference 6). Because there is a potential for wastes with which ash is co-disposed to contain such organic fluids, it is reasonable to limit the dioxin content of co-disposed ash. One part per billion is the Center for Disease Control suggested limit for the amount of dioxin contained in soils (Reference 7).

Subitem (2) requires that results of EPA Method 1312 the Synthetic Precipitation Leach Test for Soils (hereinafter "Method 1312") be less than one half the maximum leachable contaminant levels. This applies to ash which is co-disposed with other alkaline wastes as well as ash which is placed in a facility which may contain acidic wastes. Staff considered requiring that ash

which is placed in an acidic environment only meet the maximum leachable contaminant levels, not one half those levels, as long as TCLP results comply with subitem (3). However, because it is difficult to ensure that the land disposal facility is entirely acidic, staff determined that the ash should also have a low leaching potential under neutral or alkaline conditions as simulated by Method 1312. One-half the maximum leachable contaminant levels is equal to 7.5 times the Recommended Allowable Limits (RALs) for Drinking Water issued by the Minnesota Department of Health. Agency staff believes that 7.5 times the RALs constitutes "low" levels of contaminants, without being overly restrictive. (The RALs are discussed further in subpart 5 which explains how the maximum leachable contaminant levels were derived; Method 1312 is further discussed under Minn. Rules pt. 7035.2910, subpart 3).

Subitem (3) requires that results of EPA Method 1311, the Toxic Characteristic Leaching Procedure (hereinafter "TCLP" or "Method 1311") be less than twice the maximum leachable contaminant levels. The TCLP was designed by EPA to mimic co-disposal of industrial waste along with putrescible municipal wastes. Allowing the test results of ash which is to be co-disposed to exceed the maximum leachable contaminant levels which ash placed in a monofill with a single liner must meet may appear illogical at first glance. However, the TCLP is typically a much more aggressive leach test than Method 1312, especially for parameters such as lead and cadmium. It is likely that the TCLP overestimates codisposal leaching potential, because the pH of leachate collected from municipal solid waste land disposal facilities is typically between 6.0 and 7.0 (See Appendix III), whereas the TCLP uses a leaching fluid with a pH of 2 or 5, depending on the waste. On the other hand, comparison of Method 1312 to actual leachate data in general shows that Method 1312 results are very similar to actual leachate quality, with the exceptions of nickel and copper, which are typically underestimated, and lead, which in some cases has been overestimated. Therefore, the standards set by this subitem take into account the tendency of TCLP to overestimate leaching potential by slightly increasing the maximum leachable contaminant levels of subpart 5, which when used as required by subpart 4 apply to results of Method 1312.

The resulting co-disposal limits for the TCLP equal 12 to 60 percent of the hazardous waste limits, as shown in Table 1 below. To put this standard into perspective, it is useful to consider that industrial waste tested using the TCLP which does not exceed 100 percent of the hazardous waste limits may legally be disposed of in a single-lined solid waste land disposal facility. Based on

this it has been argued that ash which does not exceed hazardous waste limits when tested using the TCLP may be co-disposed in a solid waste land disposal facility. However, it may also be argued that, depending on factors such as the underlying geology, a single lined land disposal facility will not adequately protect the environment if the wastes it contains release levels of contaminants in the range of the hazardous waste limits. (See discussion below regarding subpart 5). As noted in the general discussion above regarding the reasonableness of this part, it is the Agency's intent to promulgate rules which protect the environment, based on the characteristics of waste combustor ash. Disposing of ash in a monofill optimizes the alkaline nature of the waste and the ability of that alkalinity to deter metal leaching. Therefore, unless it can be demonstrated that ash will not leach significant levels of contaminants if it is co-disposed with other wastes, it is reasonable to require that ash be placed in a monofill.

TABLE 1: WASTE COMBUSTOR ASH CODISPOSAL LIMITS

Parameter	Co-disposal Standard (2 times MLCLs)	Hazardous Waste Limit (HWL)	Standard as a Percentage of HWL
Arsenic	1,500 ug/l	5,000	30
Barium	60,000	100,000	60
Boron	18,000	N/A	
Cadmium	120	1,000	12
Chromium	900	5,000	18
Copper	30,000	N/A	
Lead	600	5,000	12
Manganese	18,000	N/A	
Mercury	60	200	30
Nickel	4,200	N/A	
Selenium	600	1,000	60
Silver	600	5,000	12
Tin	120,000	N/A	
Zinc	42,000	N/A	

N/A means not applicable because a hazardous waste limit for the parameter doesn't exist.

Subitem (4) specifies the meaning of the word "results" as used in subitems (1) to (3). The upper 80 percent confidence limit of a number of test results must be below the applicable limits of subitems (1) to (3). Only test results from a certain time period are to be considered. Specifying a time period of one year delineates a period of time long enough that a useful number of analyses is available, while still representing current ash quality. The data considered must include all analyses performed over the past year, however, so that data are not intentionally selected to make the median meet the limits for exemption, unless there is a legitimate reason to exclude certain data points, such as changes in design or operation of the waste combustor or known laboratory error.

If actions have been taken to reduce ash toxicity to meet the requirements of this subpart, it would be unfair and inappropriate to include results of ash testing performed before those actions took place. Therefore in such cases only data collected since the changes were made, up to one year earlier, must be considered.

Some persons have expressed concern regarding the selection of the statistical method used to calculate the "results" which determine compliance with this subpart, pursuant to subitem (4). General background information on statistical methods for data analysis is presented below, along with the basis for the method Agency staff has selected.

A set of data is described numerically most often by measures of central tendency (the center of the distribution of measurements) and variability (how the measurements vary about the center of distribution) (Reference 8). A number of measures of central tendency exist, including the following:

Mode: In a set of measurements, the measurement which occurs with the highest frequency.

Median: The middle value when a set of measurements is arranged in order of magnitude. Fifty percent of the measurements lie above the median and 50 percent lie below the median. It is not influenced by extreme (i.e., unusually high or low) measurements.

Mean: The sum of a set of measurements divided by the total number of measurements. The mean is also known as the "average". It is influenced by extreme measurements.

For a symmetric distribution of measurements, the values of the mode, median and mean are identical. If the distribution of measurements is skewed to the right, the largest of the measurements of central tendency is the mean. If the distribution is skewed to the left, the mean is lower than the median and mode. In each of the skewed cases, the median is the more central value. For this reason, the median is often used as the measure for locating the center of distribution if a data set is skewed.

Review of a portion of the ash testing data collected under the Temporary Program shows that the distribution for some parameters is skewed to the right (See Figure 3 and 4). In some cases this is due, at least in part, to some measurements being lower than the method detection limit, in which case the frequency histograms shown in Figure 3 to 6 assigned the "less than" data points to the interval just below the detection limit. Overall, the mean and median are relatively close, or even equal, showing that the data set in general is not extremely skewed. The differences were greatest for parameters which were not always detected above the method detection limit. In these cases, the median in nearly all cases is less than the mean.

A number of measures of the variation between data points within a set are available. The simplest is the range, which is defined as the difference between the largest and the smallest measurements in the set. Another measurement is the pth percentile, which is determined by arranging the set of measurements in order of magnitude; the pth percentile is the number for which "p" percent of the measurements are below it.

The standard deviation of a set of measurements is one of the most frequently used measures of variation. It is especially useful in cases where the frequency distribution histogram for the data is "bell-shaped," that is, the histogram has a single peak, is symmetrical, and tapers off gradually in the tails. In this case data are considered to be represented by a "normal curve," and the sample mean and sample standard deviation may be used to estimate the interval within which the true mean of the "population" (in this case, the entire amount of ash generated over 12 months) probably occurs. This interval is commonly referred to as a "confidence interval". The outer limits of the confidence interval are calculated based on the sample mean and degree of confidence with which one can expect that the true mean of the population is within the confidence interval. When a regulatory decision is to be made using sampling results to indicate the characteristics of a population, the upper limit of a confidence interval may be compared with the regulatory standard to determine compliance with a known degree of confidence.

Figure 3

Hennepin Mercury Frequency Histogram

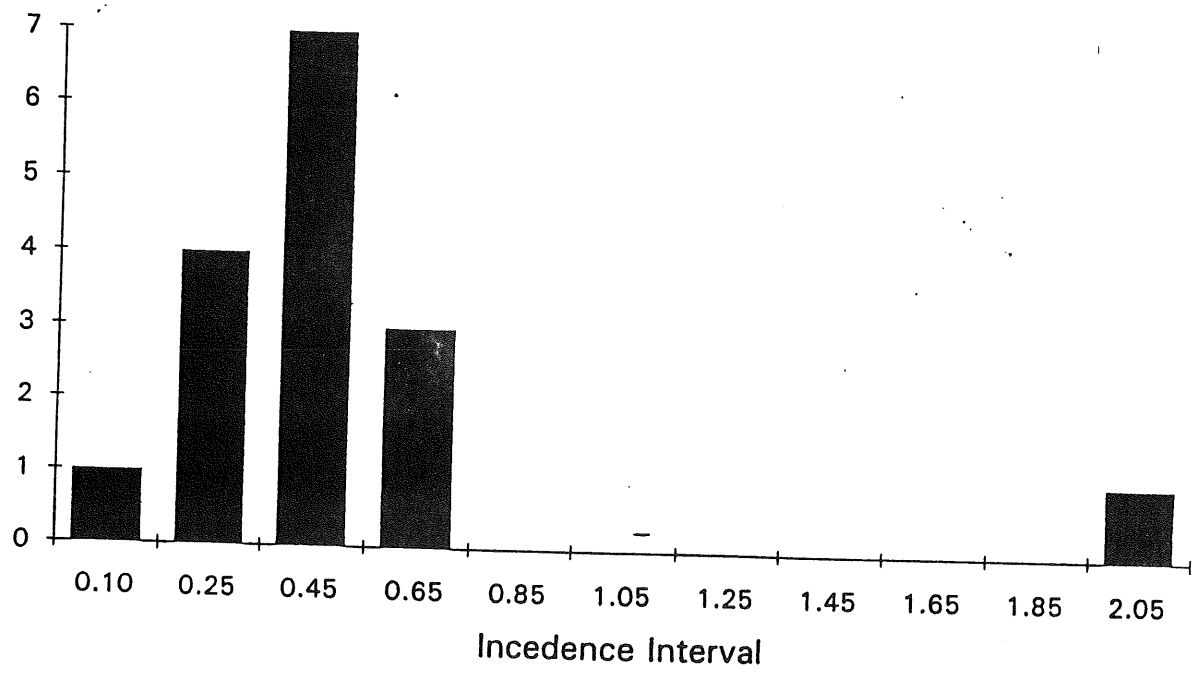


Chart13

Figure 4

Hennepin Mercury by Quarter

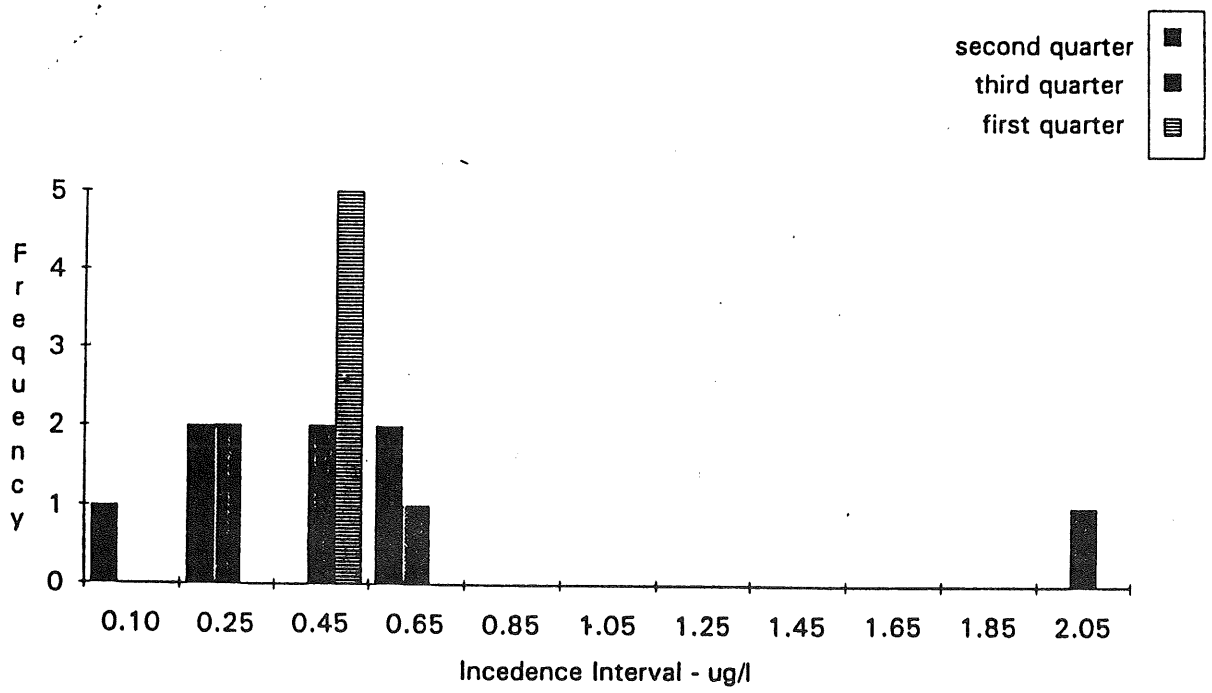


Figure 5

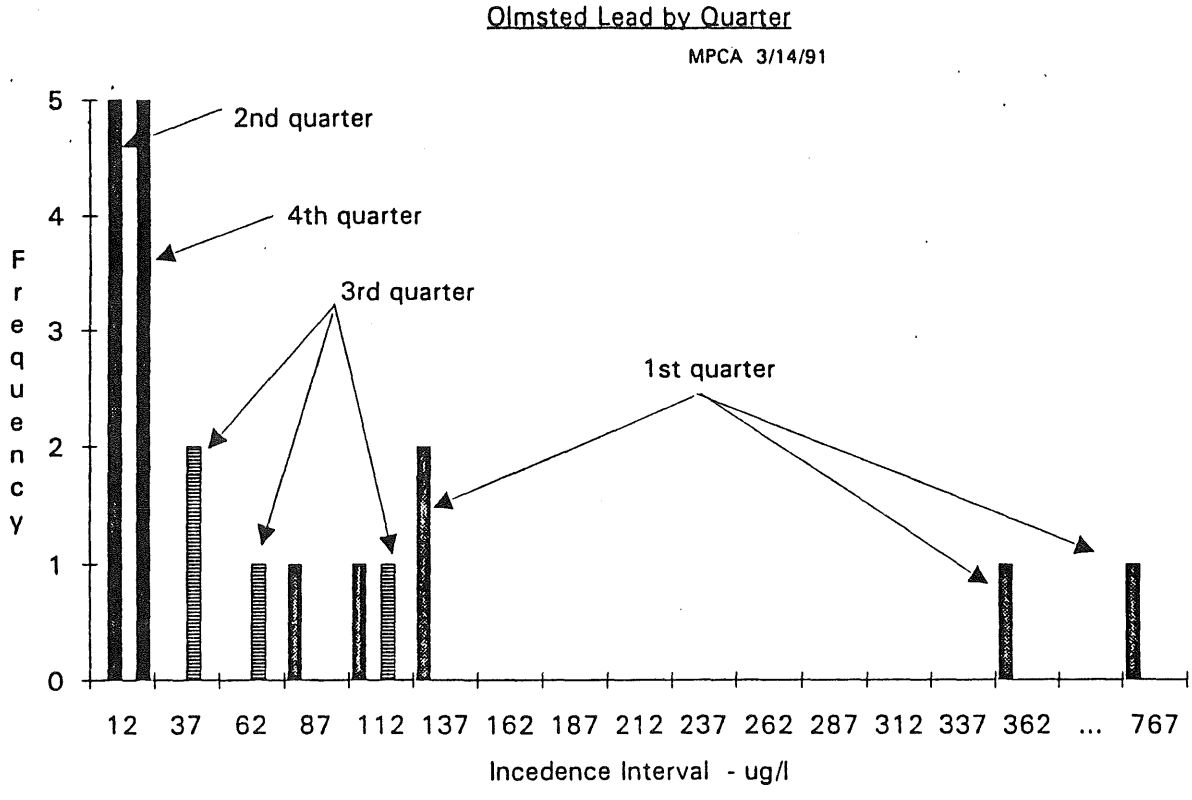
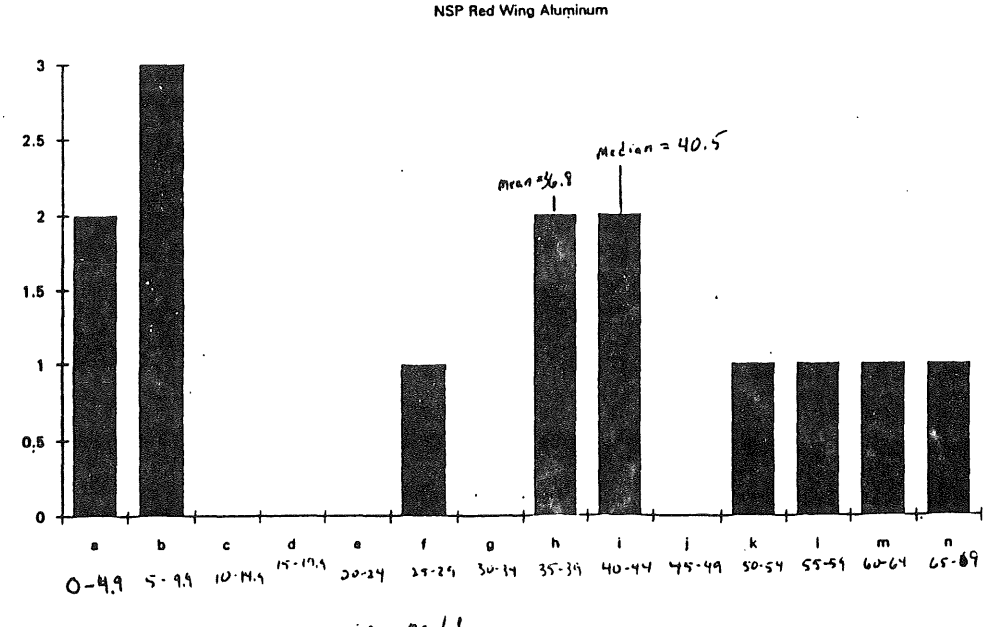


Figure 6



EPA document SW-846 "Test Methods for Evaluating Solid Waste," third edition, volume II, part III, chapter 9, discusses the statistical methods which are to be used for evaluating a waste to determine if it exceeds hazardous waste limits. See Appendix XII. This document requires that the confidence interval of 80 percent be used to determine regulatory compliance. Note that even if the upper limit of an estimated 80 percent confidence interval is only slightly less than the regulatory threshold, there is only a 10 percent (not 20 percent) chance that the threshold is equaled or exceeded by the population mean. This is because the 20 percent chance that the population mean is outside the confidence interval is equally distributed between being lower than the lower confidence interval and higher than the upper confidence interval.

MPCA staff considered three different methods for calculating the "results" to be used for determining compliance with subparts 2 and 4. The first is use of the mean, the second is use of the median, and the third is use of the upper limit of the 80 percent confidence interval. The latter has been selected because it makes use of accepted statistical methods which use the variation of the data set to predict the true mean of the population being sampled. The population mean is the relevant parameter which should be used to determine compliance.

Use of the upper confidence limit also allows the permittee to take actions, including performing more sample analyses or using laboratory methods with lower detection limits, in situations where the mean of the data set is below the regulatory threshold, but data variablility or high detection limits cause the upper confidence limit to exceed the regulatory threshold. On the other hand, in cases where the data set is clearly above or below the regulatory threshold, following the minimum ash testing requirements is adequate to determine compliance. This minimizes the burden of the minimum ash testing requirements, as opposed to requiring that a large number of samples be analyzed using low detection limits for all parameters at all facilities to ensure that data is precise enough to determine that the population mean is below the regulatory threshold.

The specified equations to be used to calculate the upper confidence interval have been taken from Table 9-1 of EPA SW-846. See Appendix XII. These equations are for data collected through a process known as stratified random sampling. This is appropriate for cases where the characteristics of the

population being sampled are known to vary over space or time nonrandomly. In the case of ash sampling, variation in data between quarters may be expected due to known seasonal variations in the waste stream. Therefore, stratification occurs overtime. Examples of stratification overtime in the data can be seen through examination of Figures 5 and 6. These figures show that the range of concentrations found by analyses of combined ash from Northern States Power (NSP) Red Wing for aluminum and Olmsted for lead using Method 1312 leach test vary significantly between quarters, while the variation between quarterly data points is much less.

For stratified random sampling, the mean and standard deviation are calculated for each stratum (each quarter in the case of ash testing). Overall estimates of the mean and standard deviation for the whole data set are then calculated using the individual strata means and standard deviations and the fraction of the population represented by each strata. For ash testing, each quarter's results in general will be considered to represent one-fourth of the 12-month production of ash. If a waste combustor does not operate for more than approximately two weeks, it is appropriate to use fractions other than one-fourth to account for the lesser volume of ash generated that quarter. For example, if a facility does not generate ash during the month of February, the first quarter only represents two months of ash out of 11-months altogether. In this case the data should be weighted as follows:

Twelve-month mean = $(2/11)(y_1) + (3/11)(y_2) + (3/11)(y_3) + (3/11)(y_4)$
where y_1 is the mean of the first quarter's data, y_2 is the second quarter data mean, and so on.

There are a number of advantages to use of the stratified random sampling equations. First, the overall standard deviation is less, as long as the inter-quarter variation is less than the variation within the 12-month data set. Consequently, the confidence interval is narrower than that calculated based on the data set as a whole, and the upper confidence limit is lower. In cases where inter-quarter variation is not less than the 12-month data set, the upper confidence limit is the same as that calculated using simple random sampling equations (See Table 2).

Also, even if the number of samples analyzed for each quarter is not the same, the 12-month mean is equally affected by each quarter. Conversely, if the

TABLE 2

COMPARISON OF UPPER CONFIDENCE INTERVALS FOR SIMPLE AND STATIFIED SAMPLING
MPCA 3/14/91

(all data are results of combined ash analysis for lead; results in ug/l)

	Simple Random Sampling			Stratified Random		
Facility	mean	std.dev.	UCL	mean	std.dev.	UCL
Olmsted (n = 21, quarters = 4)	109	195	166	100	151	144
Richards (n = 13, quarters = 4)	82	85	114	85	20	93
Hennepin (n = 16, quarters = 3)	6900	2300	7700	6900	2400	7700

UCL = upper confidence limit

std.dev. = standard deviation

n = number of samples analyzed

data set is considered as a whole, and more samples are analyzed for one quarter, the results for that quarter will have a greater effect on the overall mean than results from other quarters. This is important because a facility may wish to increase the number of samples analyzed in order to decrease the width of the confidence interval if their sample results for one or more parameters are close to the regulatory limit.

For parameters analyzed annually rather than quarterly, the mean, standard deviation and confidence interval are to be calculated using simple random sampling equations. There is no reason to believe that data from a well-mixed composite sample are stratified, so the equations discussed above for stratified random sampling do not apply.

3. Subpart 3. Acceptable Wastes.

This subpart requires that ash be disposed of separate from other wastes except those approved by the commissioner for codisposal with ash. It is known that pH affects the solubility of chemicals. Lead and cadmium have been identified through EP toxicity leach testing as contaminants which are often present in waste combustor ash at levels of concern, sometimes exceeding hazardous waste limits (Appendix XIII and Attachment 2 to Appendix II). Because the solubility of lead and cadmium is greater at pHs below neutral than it is at neutral to moderately alkaline pHs, and combined ash characteristically is alkaline, keeping ash separate from acidic wastes reduces the likelihood of lead and cadmium leaching from the ash.

For most waste combustors, disposal of ash in a separate cell from municipal solid waste does not require a major change from ash management practices which would likely be followed if separate ash disposal were not required. In most cases ash would go to the same location even if it could be co-disposed. Most waste combustors have made arrangements with an existing municipal solid waste land disposal facilities to provide ash monofill disposal capacity. In situations where the waste combustor and land disposal facility are not owned by the same entity, the separate ash disposal requirement can present some extra complications to contract development, because the land disposal facility owner needs to be assured that enough ash will be produced to eventually fill the waste combustor ash cell to gain the full economic benefit of the monocell they have built.

Co-disposal of other wastes which would not increase leaching potential, (e.g., medical waste incinerator ash) is allowed. It is reasonable and prudent to dispose of similar wastes together. In situations where a land disposal facility owner constructs a cell for ash only, this allows them to accept other approved wastes, which may alleviate some of the contract concerns identified above. Most importantly this may decrease the amount of metals found in municipal solid waste land disposal facility leachate by segregating other wastes which contain metals which leach more easily in an acidic environment. According to Appendix XIV, municipal solid waste land disposal facility leachate often contains higher levels of metals than waste combustor land disposal facility ash.

To decide whether MPCA staff should review each request for disposal of non-ash wastes in a waste combustor ash cell, staff considered the following: After revised Solid Waste rules were promulgated in 1988, the MPCA discontinued the industrial waste co-disposal review and approval program. Rather, responsibility was put on the operators to do their own review of requests to take industrial wastes. Part 7035.2535, subpart 5, requires owners and operators of solid waste facilities to decide what industrial wastes to accept and how to handle them based on an approved industrial waste management plan submitted in accordance with part 7001.3300, item B. Staff believes, however, that this type of program should not be used for waste combustor ash land disposal facilities. Rather, because of the importance of properly limiting the type of wastes co-disposed with waste combustor ash, and the greater complexity of the criteria to be considered in deciding if co-disposal of a waste is acceptable, it is appropriate that MPCA staff have the opportunity to review each co-disposal request. Because the number of waste combustor ash land disposal facilities is less than the number of municipal solid waste land disposal facilities, and the number of industrial wastes which may be eligible for codisposal is fairly small, reviewing co-disposal requests for waste combustor land disposal facilities should not require a substantial amount of MPCA staff time.

A question has been raised in the past whether used bag houses from dry scrubbers are automatically acceptable at an ash-only site. Bag houses are made of fiberglass, and may contain some fly ash. A small quantity of bags are discarded each year (only three facilities currently use dry scrubbers). Some facilities elect to burn the bags in their waste combustor, others discard them

with ash. Although MPCA staff believes the bags are inert and would not affect ash leaching potential, approval must still be obtained from the director for co-disposal at an ash site. If an allowance is made for bag house disposal, where the line is drawn in deciding what wastes need co-disposal approval becomes blurred. It is better to require clearly that anything other than municipal solid waste waste combustor ash needs Commissioner's approval for cod-isposal. Refractory from inside waste combustor burning chambers is another example of a waste which may be appropriate for co-disposal with ash, but should be approved first. Slag (ash which has become molten, then hardened, sometimes remaining inside the combustion chamber) is ash and does not require codisposal approval.

4. Subpart 4. Limitation of Leachable Contaminants.

This subpart forbids disposal of ash which contains leachable contaminants above the levels given in subpart 5 in a waste combustor ash land disposal facility, unless: 1) the ash is treated to meet the limits, or 2) the facility meets the more stringent final cover and liner design standards set out in subpart 10, item C, subitem (3) and subpart 11, item O or P. In addition to complying with the goals of Minn. Stat. § 115A.97 (Appendix I), limiting contaminant content in leachate is needed for a number of reasons.

First, reducing leachate contaminant content reduces the potential for ground water contamination at a waste combustor ash land disposal facility. This conforms to the "nondegradation policy" of Minn. Rules ch. 7060, which states that ground water may not be contaminated in such a way that it can no longer be used as a safe source of drinking water. According to the Minnesota Ground Water Protection Strategy developed by the MPCA and the Environmental Quality Board (Exhibit IV) "Nondegradation . . . should be the policy goal of the State in the regulation of all potential sources of contamination. . . . While this goal is not currently achievable for many activities, the nondegradation goal will provide impetus for adopting improved technologies as they are developed". The strategy also calls for requiring the use of "Best Available Technology" for permitted facilities and practices. For waste combustor ash management, treatment of ash which contains significant levels of contaminants or installation of a secondary containment system and high

efficiency final cover may be considered use of Best Available Technology to protect ground water.

Second, it is difficult to treat liquid waste which contains metals. If leachate is taken to a waste water treatment plant, metals will either accumulate in sludge or be released to surface waters. If leachate is used to moisture-condition waste prior to combustion, metal air emissions may increase because a percentage of metals volatilized during combustion, particularly mercury, are not captured by pollution control equipment (although based on Agency staff calculations, the contribution of metals from leachate to air emissions appears to be negligible). If leachate is used as quench tank make-up water at a waste combustor, metals in leachate will be returned to the ash land disposal facility with ash which has absorbed quench water. It is preferable to reduce the amount of metals contained in leachate whenever possible, rather than attempting to treat contaminated leachate after it is produced.

Third, reducing the level of contaminants in ash leachate reduces the burden of waste combustor ash land disposal facilities on future generations. At a minimum, the potential for ground water contamination and consequently the need for remedial action is reduced because long-term reliability of liners becomes less important. In addition, if the level of contaminants in leachate becomes low enough, it would not be necessary to continue removing and treating leachate from the land disposal facility after it has been closed. The small amount of leachate generated after final cover is placed could be allowed to seep gradually through the liner without causing significant degradation of underlying aquifers.

Requiring that ash which contains high levels of leachable contaminants be contained through ash treatment or use of extra engineered controls at a land disposal facility is reasonable because: 1) treatment technology exists, 2) liner technology exists, and 3) the cost of containment may be offset by reduced leachate treatment costs and reduced financial assurance requirements due to a decreased need for contingency action funds.

According to a number of sources, the technology exists to treat waste combustor ash to reduce contaminant mobility. According to Reference 9:

> Several general approaches exist for the treatment of incinerator residuals. These can be broadly classified as solidification or fixation, vitrification or glassification, and component separation and recovery. Solidification and fixation retain the potentially

> hazardous constituents in a pozzuolonic [or] bituminous matrix. Chemical additives are most often employed to maintain physical and chemical integrity. This process can result in significant increases in the volume of materials requiring disposal. Vitrification and glassification incorporate heavy metals into a silica matrix through high temperature processing. The disadvantages of this technology are the energy requirements and the potential for volatilization and release of heavy metals and chlorides. A disadvantage common to all immobilization techniques is the potential long-term fate and liability associated with hazardous components. The third approach, component separation and recovery, relies on removal and recycling of potentially hazardous constituents, returning metals (bulk, e.g., ferrous, and trace, e.g., lead and cadmium) to the marketplace and allowing reuse of the inert constituents as an aggregate. Application of each approach is based on initial residuals [ash] properties, desired end uses and economics.

In September 1989, a worldwide group of leading experts in the field of municipal solid waste combustion put together by the U.S. Conference of Mayors' Coalition on Resource Recovery and the Environment met to "comprehensively review and evaluate the current state of the art in municipal solid waste incineration." One consensus of the group was that "post combustion treatment technologies for ash residue already exist or are under evaluation . . . includ(ing) stabilization, vitrification, and residue metals extraction. These processes all have the potential to improve the characteristics of residues for utilization or disposal". This expert group also concluded that residue management options "should take into account both short-term and long-term environmental consequences of disposal effects, e.g., the notion of environmentally safe release rates, creative use of landfill caps, and consideration of the ultimate fate of leachates" (Reference 4).

Research on metals separation and recovery performed by Kosson, Legiec and Hayes at Rutgers University has succeeded in removing 70 percent to 85 percent of lead and more than 95 percent of cadmium contained in samples of waste combustor fly ash. Through the use of electroplating metals can be recovered in a relatively pure, reusable form.

The deadline for compliance with this subpart, January 1, 1993, allows approximately 15 months for persons to come into compliance with this requirement. This time should be adequate for facilities to review their data to see whether they will exceed the maximum leachable contaminant levels, and if it appears they will, to permit and construct an ash containment system. Extensions of this date are discussed under item D.

Item A clarifies that except as allowed or required by items B and C, the results of Method 1312 laboratory leach tests are to be used as the basis for determining compliance with this subpart. The upper 80 percent confidence limit of one year's results is specified as the basis for determining compliance for the same reasons discussed under subpart 2 regarding compliance with exemption requirements. Use of the upper 80 percent confidence limit implies that there is a 90 percent probability that the population mean (i.e., the actual average quality of the ash) is less than the regulatory limit, in this case the maximum leachable contaminant level. This justifies selection of maximum leachable contaminant levels which are less conservative than those which staff would have selected had the mean or median of the data set been used to determine compliance.

Item B allows use of actual leachate data in some cases and item C requires its use in other cases to determine compliance with this requirement. Actual leachate may be affected by a number of factors independent of ash quality, such as collected clean rainwater falling on a newly lined area. Therefore actual leachate data is not expected to be as consistent a gauge of leachable contaminant levels in ash as the Method 1312 leach test, particularly for a new phase. In light of this, subpart 4 allows use of actual leachate quality in place of Method 1312 results only in cases where the actual leachate data is from a phase which is at least one-half full. After the phase is half full, leachate must pass through a significant amount of ash, making leachate analysis a better prediction of the leachate quality which may be expected in the future.

Item B requires that actual leachate analyses which are used in place of Method 1312 be from a phase of the land disposal facility which received ash from the waste combustor during the quarter. A "phase" is defined as an area of the land disposal facility which is served by its own leachate collection system which may be sampled independently. The goal of this provision is to ensure that results used to determine compliance represent recently produced ash. In some cases, it may be difficult for the owner or operator of an ash monofill to obtain leachate samples which provide a good representation of recent ash. For example, consider an ash monofill which consists of eight phases, where each phase is constructed as needed, and is sized to contain two years' worth of ash. If leachate from one phase could be sampled and analyzed to replace Method 1312 data (starting after the phase is one-half full, as required by subitem (1)), the data would represent the ash quality of eight or fewer quarters. However,

if the leachate from all phases is directed to one collection point, where it is sampled, it would not be possible to separately sample leachate from one phase. After four years of operation, leachate collected from the entire facility would represent approximately 16 quarters of ash. The effect of one quarter's ash on the facility's average leachate quality would be stifled by the effect of the other 15 quarters of ash. After ten years, 40 quarters of ash would be served by one leachate collection facility. Hence, Agency staff believes it is necessary to limit use of actual leachate data to situations where leachate may be sampled which will reflect the quality of a given quarter's ash.

Comparison of actual leachate to results of Method 1312 shows that magnesium, copper, and nickel are typically underestimated by Method 1312 by a factor of 10 or more (Appendix XIV). To account for this, item C requires that the results of Method 1312 or actual leachate, whichever is higher for a given parameter, be used to determine compliance with this part. Because actual leachate quality directly affects how effectively compliance with the maximum leachable contaminant levels will protect ground water, it is reasonable to use actual leachate data to determine compliance in situations where actual leachate is more likely than Method 1312 results to predict long-term leachate quality. The Ash Rules Task Force was in agreement on this point.

If ensuring that ash meets the maximum leachable contaminant levels allows the permittee to cease leachate collection at some point in the future, the potential savings (present value) is estimated to be approximately $120 per acre per year. This is based on an estimate of leachate treatment costs of 78 cents/100 ft^3 of leachate and estimated annual leachate production after closure= 1,140 gallons per acre= 153 ft^3 per acre (ESL Illinois landfill data for a closed facility with a synthetic final cover barrier layer). For a less efficient final cover, leachate treatment costs would be greater.

Item D allows a permittee to request an extension of up to two years if he or she is unable to complete preparations needed to meet this requirement. This is needed because of the difficulty of predicting the amount of time needed to locate, permit and construct an ash treatment system, since no waste combustor ash treatment facilities have been constructed yet in Minnesota. Although construction of a double-lined ash disposal facility is another option allowed, such construction also requires Agency review and approval. It would not be reasonable to penalize an owner or operator for noncompliance caused by lengthy Agency review time due to factors outside the owner's or operator's control.

5. Subpart 5. Maximum Leachable Contaminant Levels.

The maximum leachable contaminant levels have been derived based on existing health risk standards and guidelines, calculated factors which affect migration of pollutants from a land disposal facility, and general consideration of the relative environmental threat posed by a municipal solid waste incinerator ash land disposal facility. These points are discussed in detail below.

a. General Considerations.

The maximum leachable contaminant levels must maintain a balance between conflicting needs. They must be appropriately protective with a reasonable safety factor to account for the many uncertainties which exist regarding underlying soils and aquifers, the concentration of contaminants in leachate which may be expected in the future, and the interactions between contaminants and soils. On the other hand, given the evidence that contaminants which are typically present in ash leachate do not appear to migrate easily, it does not appear necessary to set maximum leachable contaminant levels at extremely conservative levels. Contamination from mixed municipal solid waste land disposal facilities in most cases stems from migration of toxic organic constituents, not metals, into ground water. In cases where metals have been found in contaminated ground water, the site has been located in an area underlying by sandy soils which have little or no attentive capacity. Examples include Oak Grove Sanitary Landfill (arsenic and barium contamination) and Herbst Demolition Landfill (barium contamination) which are both located over the Anoka sand plain.

A range of maximum leachable contaminant levels which could be selected exists. This range is bounded by the lowest and highest numbers which have some reasonable basis. The lowest values considered are the ground water performance standards (ground water performance standards are discussed below). These numbers are the maximum allowable degradation of ground water at a solid waste land disposal facility. If one conservatively assumes zero liner effectiveness and no dilution or attenuation of pollutants as leachate travels from the fill area to the ground compliance boundary, concentrations of pollutants in leachate

would have to be less than the ground water performance standards.

The high end of the range is the hazardous waste limits. If waste tested using the TCLP, a test designed to mimic co-disposal of industrial waste along with putrescible municipal wastes, does not exceed the hazardous waste limits, it may legally go to a single-lined solid waste land disposal facility. Therefore, it may be argued that waste going to a monofill which does not exceed hazardous waste limits when tested using Method 1312, a test which is considered to predict the leaching potential of wastes in a monofill environment, may be disposed of in a single-lined landfill.

However, there are reasons that neither of the above limits are appropriate. Regarding the use of the ground water performance standards, scientific data exist which show that liners do provide significant ground water protection, with estimates showing that less than 1 percent of leachate leaks through a typical composite liner. Soils, including clays used to construct composite liners, are known to impede pollutant migration through cation exchange and other factors. Therefore, it is reasonable to assume that a facility which complies with design requirement of subparts 10 and 11 will greatly retard the migration of pollutants to ground water. Factors must be established which take these points into account, along with the probability that leachate is diluted upon entering ground water.

Use of the hazardous waste limits as the maximum leachable contaminant levels is also not reasonable for a number of reasons. First, the TCLP is a much more aggressive leach test than Method 1312 for parameters such as lead and cadmium. It is likely that TCLP overestimates co-disposal leaching potential, based on the fact that the pH of leachate collected from municipal solid waste land disposal facilities is typically between 6.0 and 7.0 (Appendix III), whereas the TCLP uses a leaching fluid with a pH of 2 or 5, depending on the waste. On the other hand, comparison of Method 1312 to actual leachate data in general shows that Method 1312 results are very similar to actual leachate quality, with the exceptions of nickel and copper, which are typically underestimated, and lead, which in some cases has been overestimated. The hazardous waste rules use the TCLP test for classification of waste, regardless of the waste disposal method. Therefore, it is reasonable to apply a safety factor to the hazardous waste limits to account for the less aggressive nature of the Method 1312 leach test which is being used to determine compliance with this part. Second, if actual land disposal facility leachate did equal the

hazardous waste limits, based on the Solid Waste SONAR modeling discussed below, it appears that a single liner would not provide adequate protection except in areas with considerable ability to attenuate pollutant migration. Finally, the hazardous waste limits were set at 100 times the federal drinking water standards in place at the time. The RALs are considered to be more up to date than these standards for a number of parameters, so that setting maximum leachable contaminant levels using a multiple of the RALs is more appropriate than using the hazardous waste limits.

The considerations listed above narrow the reasonable range within which the maximum leachable contaminant levels should fall to something greater than the ground water performance standards, and something less than the hazardous waste limits, at most 100 times the RALs. Through the process and considerations discussed below, the Agency has established the maximum leachable contaminant levels at 15 times the RALs.

b. Use of Existing Standards as a Basis.

It is reasonable to set the maximum leachable contaminant levels using existing standards or guidelines which are based on health risk assessments and environmental protection for the parameters of concern. A number of such standards and guidelines exists. Table 3 lists potential routes of pollutant release from an ash land disposal facility, along with applicable standards and guidelines. From this list the Agency has focused on the first two routes, which relate to ground water impacts, in setting the maximum leachable contaminant levels. The applicable standards for this route are the ground water performance standards of the Solid Waste rules and RALs for drinking water.

i) RALs and ground water performance standards.

The solid waste rules promulgated in 1988 establish a system for defining contamination from a land disposal facility. The system consists of ground water quality standards, which are limits on the concentration or severity of ground water pollution, and compliance boundaries, which limit the area around the facility that may be impacted to levels which exceed the standard. Note that the solid waste rules list a set of numbers that have two different applications, one as trigger levels (the intervention limits), the other as

Table 3

Potential Routes of Exposure for Escape of Contaminants from a Waste Combustor Ash Monofill

Minnesota Pollution Control Agency
March 19, 1991

ROUTE	RECEPTOR	APPLICABLE STANDARDS	FACTORS WHICH INFLUENCE CONCENTRATION AT RECEPTOR
1. LDF TO GW TO WELLS	human cosumption of well water	RAL	Dilution, attenuation, liner performance
2. LDF to GW	Ground Water	Non-degredation policy, Intervention Limits	Dilution, attenuation, liner performance
3. LDF to GW to Surface Water	Surface Water	Surface Water Criteria	Dilution by ground water and surface water, and attenuation
4. LDF to WWTP	a) plant itself b) surface water c) sludge (air or ground)	WWTP pretreatment standards	Treatment by WWTP, attenuation on soils, dilution by surface water
5. LDF to WC (as quench water)	possibly air	MPCA review of leachate treatment plan	
6. LDF to Air (dust)	Surrounding soils, humans through ingestion or inhalation, surface water	Dust control requirements, soil lead content	

Abbreviations:
LDF = Land Disposal Facility GW = Ground Water RAL = Recommended Allowable Limits
WWTP = Waste Water Treatment Plant WC = Waste Combustor

enforceable "standards." The two are not the same. The numbers serve as triggers of various responses at locations inside the compliance boundaries. They become standards, in the sense that they must be complied with, at or outside the compliance boundary. For the purposes of this discussion, the term ground water performance standards is used.

The ground water performance standards are given in Minn. Rules pt. 7035.2815, subpart 4, item F, which reads "except as provided in items E and H and this item, pollutant concentrations in ground water must not exceed the standards listed in this item at or beyond the compliance boundary and at or below the lower compliance boundary." (Item E applies to selection of surface water performance standards for situations where a surface water is designated as a compliance boundary. Item H allows the Commissioner to set alternative standards in a number of cases, including where the concentration of a constituent in the background water at a facility is greater than the ground water performance standard). The ground water performance standards give all affected parties a precise measure of the severity of ground water contamination which can be used to guide decision making.

At the time Minn. Rules pt. 7035.2815 was promulgated in 1988, the ground water performance standards were set at one-fourth of the "RALs," February 1986 edition. The RALs are set by the Minnesota Department of Health and are applied to private drinking water supply wells. All RALs are substances of concern due to their potential toxicity or carcinogenicity when ingested by humans References 10 and 11). Ground water performance standards were set at 25 percent of the RALs because the Agency believes that in light of the state's nondegradation policy, lined containment facilities should be held to a higher standards of performance than mere compliance with drinking water standards. This is discussed in further in the Solid Waste SONAR, pages 357 to 367 (Appendix XV).

There are two problems with using the current ground water performance standards alone for setting the maximum leachable contaminant levels. First, they do not exist for some parameters of concern for which RALs have been issued in the 1988 or 1991 version. Second, the 1986 RALs used as the basis for some of the ground water performance standards have been changed.

In light of the relationship between ground water performance standards, RALs and ground water protection, the starting point for calculating the maximum leachable contaminant levels was set at one-fourth of the 1991 version of the RALs. For nine parameters, an RAL which varies from those specified in the 1991

version has been used. For eight of those parameters (boron, manganese, mercury, nickel, selenium, silver, tin, and zinc) the Department of Health has stated that they intend to change the RALs. See Appendix XVI. For these parameters, the proposed RALs have been used. The RAL for arsenic is based on the 1988 RAL because the 1991 RAL is so low that most ambient, uncontaminated ground water will exceed the limit. Agency staff has requested that the MDH reconsider this limit, because it is not feasible for the Agency to use the 1991 number in this situation and many other regulatory situations. See Appendix XVII. Table 4 shows the RALs and ground water performance standards, as well as results of laboratory leach testing of combined ash and analysis of actual ash monofill leachate.

ii) Rejection of standards other than the RALs and ground water performance standards.

As noted above, selection of the maximum leachable contaminant levels focused on only the first two pollutant release routes identified on Table 3. The reasons for this are as follows:

Maximum leachable contaminant levels are based on ground water-related standards to keep the concentration of toxic contaminants in leachate low enough that ground water contamination is very unlikely. The maximum leachable contaminant levels were not based on surface water standards because leachate which has been collected by the leachate collection system above the landfill liner(s) may be monitored and treated much more easily than ground water. Using leachate analysis which provides a direct measurement of the concentration of contaminants, leachate may be treated as necessary. On the other hand, the degree of contamination of ground water can only be estimated using the grid of monitoring wells established. If this system indicates that significant contamination has occurred, both the leachate and the ground water it has mixed with must be treated. Thus the volume of contaminated liquid which must be managed has increased, and a system must be constructed to collect the contaminated ground water. Also, treatment may have to continue long after the facility is closed because of the slow rate of ground water movement.

The effect of contaminated ground water on surface waters near an ash land disposal facility was also considered. There are some parameters for which surface water criteria are significantly lower than the RALs. However, the Agency determined that this route did not warrant use of surface water criteria for setting the maximum leachable contaminant levels for three reasons. First,

Table 4

STANDARDS AND DATA RELEVENT TO SELECTING MAXIMUM LEACHABLE CONTAMINANTS LEVELS

(all in ug/l)

Minnesota Pollution Control Agency
March 19, 1991

Parameter	RAL[a]	GW Performance Standard[b]	Hazardous Waste Limit	Method 1312 Mass Burn	Method 1312 RDF	Actual Leachate[c] Range of Facil. Medians Minimum	Actual Leachate[c] Range of Facil. Medians Maximum	Propos Maximum Leachable Contaminant Levels
Arsenic	0.2	12.5	5000	#50[d]	#325	<2	50	750
Barium	2000	375	100,000	311	#413	240	240[e]	30,000
Boron	300			range:#27 to 510				9,000
Cadmium	4.0	1.25	1,000	#4.8	#11.3	<0.1	10	60
Chromium(VI)[f]	100.0	30	5,000	#5.8	#16.7	8	14 (or <50)	450
Copper	1000	325	none	#99	<16.7	<10	1,110	15,000
Lead	20.0	5.0	5,000	#910	#52	0.5	100	300
Manganese	300	none	none	#1.8	<16.7	2,000	10,500	9,000
Mercury	1	0.75	200	#0.8	#0.8	<0.2	2	15
Nickel	70	38	none	#4.4	<16.7	<5	105	2,100
Selenium	10	11	1,000	#51	#16	<2	10	300
Silver	10	none	5,000	#5.4	<17	20	20[e]	300
Tin	2,000	none	none		<15 (1 facility)			60,000
Zinc	700	none	none	#307	#21	10	390	21,000

a RALs = Recommended Allowable Limits, as set by the Minnesota Department of Health in January, 1991
b Ground water performance standards are contained in the MPCA Solid Waste rules. They were set at 1/4 the RALs issued in 1986.
c Data shown is from Minnesota Type II ash monofills.
d # indicates an average calculated using the detection limit where the parameter was detected in at least one but not all samples tested. < indicates that the parameter was not detected at all.
e For these parameters only one data point was available, so the minimum and maximum are identical.
f There are two RALs for chromium; however, ash and leachate samples have only been analyzed for total chromium.

Minn. Rules pt. 7035.2885, subpart 4, item E allows the Commissioner to designate a surface water body as a compliance boundary and set ground water performance standards for the surface water based on applicable surface water criteria of Minn. Rules ch. 7050. Second, parameters for which maximum leachable contaminant levels are set will serve as indicators of contamination at ground water monitoring points between the fill area and surface waters. Third, dilution of ground water as it enters surface water is often great enough to render pollutant concentrations insignificant.

Treatment of leachate at waste water treatment plants is also identified as a potential route of pollutant release. Leachate treatment at a waste water treatment plant is considered an industrial discharge. Because a regulatory program which applies to industrial discharges already exists, the Agency did not set maximum leachable contaminant level based on criteria relating to waste water treatment plants. Some persons have stated that maximum leachable contaminant level should be set considering this route because the waste water regulatory program inadequately protects surface waters, considering that bioaccumulation of toxics in aquatic life appears to be a significant source of human exposure to pollutants. However, it is more appropriate and efficient to correct any such inadequacies through changes to that regulatory system rather than through this and other rules which regulate a facility which produces waste water. Furthermore, establishment of maximum leachable contaminant levels indirectly reduces the burden of leachate on waste water treatment plants by establishing an incentive for keeping leachate pollutant concentrations as low as possible.

The sixth exposure route, dust emissions, is not a basis for maximum leachable contaminant levels because dust emissions are not affected by the leachable contaminants, but rather the total concentration of toxic contaminants contained in fine particulate. Dust control is addressed in subpart 10.

c) Selection of a Dilution Factor.

A dilution factor of 1.5 has been calculated using a model discussed on pages 437 to 446 of the Solid Waste SONAR. See Appendix XVIII. This model predicts the concentration of a parameter in a ground water monitoring well assuming only dilution of leachate by ground water, neglecting effects of dispersion, adsorption, and other factors which impede pollutant migration. The

dilution factor is calculated by dividing the concentration of the parameter in leachate by the predicted concentration in ground water after dilution.

For the calculations performed for the purposes of this SONAR, the predicted dilution factor varies depending on the predicted volume of leachate seeping through the landfill liner (this will be called "leakage" for the purposes of this discussion). The volume of ground water is assumed to be the same as that used for the Solid Waste SONAR model, which was calculated assuming a silty sand aquifer moving at 0.30 feet/day, with a hydraulic gradient of 0.006 feet/foot, a mixing depth of 25 feet and a width of 1000 feet. The model assumes a fill area size of 20 acres. To determine the dilution factor which may be expected at an ash land disposal facility, various leakage rates were calculated based on a number of predicted leachate generation rates and liner and cover efficiencies. Different predictions apply to open (i.e., active) facilities and closed cells. It was necessary to consider both of these cases to determine the minimum dilution which may be expected over the life of a facility.

Results of these calculations show that 1.5 is the approximate minimum dilution factor that may be expected. This number was predicted by a number of different scenarios, including:

1. After closure, based on 30 inches of precipitation per year, and evapotranspiration only (i.e., barrier layers in cover and liner were assumed to be completely ineffective); the HELP model predicts that after good vegetative cover is established evapotranspiration (the transfer of water from soil to the air through a combination of direct evaporation and uptake and release by plants) prevents 97.8 percent of the precipitation from seeping through the liner and becoming leachate; (Exhibit V);

2. After closure at the ESL landfill in Illinois, which has produced less than 4,000 gal/month since closure, assuming 0 percent liner efficiency (based on long term situation where leachate is no longer collected);

3. During active operations (i.e., an open cell), where 30 inches of annual precipitation all becomes leachate, and the liner functions at an efficiency of 98 percent; and

4. During active operations, where 15 inches of precipitation becomes leachate, and the liner functions at an efficiency of 96 percent.

Note that the volume of leachate produced by 15 inches of rain (the amount of infiltration expected for 30 inches of annual precipitation of which 50 percent evaporates) is approximately 1,115 gallons/acre/day. Data from the ESL landfill (Reference 12) confirms this figure: the annual average leachate production is 1,160 gallons/acre/day (although this may be higher than normal because wash water from the metal recovery area is added to the ash monofill). Data from three years of operation at the Olmsted-Dodge ash site averages 600 gallons/acre/day. Polk County reported total leachate generation for 1990 of 88,000 gallons, which approximately equals an average of 200 gallons/acre/day. This data indicates that the volume used for the estimate in scenario 4 above is conservative in some cases.

Also, according to a report prepared by Geoservices for EPA (Reference 13), a composite liner conforming to the specifications of this part is predicted to leak at a rate of only 0.1 gallons/acre/day. Scenarios 3 and 4 above are based on a leakage rate of approximately 40 gallons/acre/day, an increase of 400 times over the rate predicted in the report. This shows that the liner efficiencies assumed which predict a dilution factor of 1.5 for an open landfill are likely very conservative. If this is the case, the situation of a closed landfill without a functioning liner system is the limiting factor.

The model predicts higher dilution factors for other scenarios. For example, the Solid Waste SONAR predicts a dilution factor of two for a closed landfill constructed using a four-foot clay liner with a permeability of 1×10^{-8} cm/sec and a clay cover. A "best case" prediction of 9.2 was estimated for a closed site with a synthetic barrier layer in both the final cover and liner, with a liner efficiency of 95 percent (i.e., assuming leachate is collected). For a liner efficiency of 99 percent for the same case, a dilution factor of 34.0 is predicted. Both these "best case" predictions are based on actual leachate generation data from ESL landfill in Illinois, where less than 38 gallons/acre/day have been generated since placement of the final cover.

Relative to a municipal solid waste land disposal facility, the Agency expects that an ash land disposal facility cell will produce more leachate

during its open life and less after closure because: 1) municipal solid waste can adsorb a lot of water before it reaches saturation, whereas most ash is close to saturation at the time it is delivered to the disposal facility, and 2) after closure municipal solid waste produces liquids as it decomposes, whereas ash is not subject to decomposition. Therefore, one could expect that the time period of most concern for ash is during the active life rather than after closure, even assuming liner failure after closure. However, because of the difficulty of predicting the effectiveness of cover and liner barrier systems indefinitely, the Agency made the conservative assumption that these barrier systems have no effect after closure, and that evapotranspiration is the only means of rejection of precipitation. According to the HELP model, evapotranspiration is significant after good vegetative cover has been established. Placement of topsoil which has a high water holding content as the top layer of the final cover may increase the evapotranspiration rate even further. Because evapotranspiration is a natural process that occurs to varying degrees on any ground surface, the Agency believes it is reasonable to count on evapotranspiration continuing to occur indefinitely into the future. It is by chance that these two scenarios, the open landfill with a functional liner and the closed landfill without barrier layers, are predicted to result in approximately the same dilution factor.

d) Selection of an Attenuation Factor.

The model from the Solid Waste SONAR which was used to calculate a dilution factor as discussed above is simple and conservative in most ways. The Solid Waste SONAR acknowledges that factors not considered exist which would serve to reduce the concentrations of leachate in ground water. These include adsorption, precipitation, and dispersion which attenuate the migration of pollutants to and in ground water. The simple model was chosen to assess the adequacy of the rules for the entire state, i.e., regardless of the subsurface soil conditions at a site. The Solid Waste SONAR model found that simple dilution only reduced pollutant concentrations by a factor of approximately two. Therefore, most of the pollutants which exceeded the ground water performance standards in the leachate to start with also violate the standard in the predicted monitoring results, including many of the inorganic pollutants such as

lead. The Solid Waste SONAR states "The Agency believes that the other factors involved in the transport of pollutants in ground water provide natural treatment mechanisms that will decrease the potential for detrimental environmental impacts." (Descriptions of adsorption, dispersion and degradation are provided). "It is expected that metals such as lead, mercury, and cadmium ... will be retained in the clay liner." Six scientific references are cited as the basis for this statement. See pages 446 to 447 of Appendix XVIII.

For the purposes of these rules, it is reasonable to assume that attenuation will reduce the migration of pollutants contained in leakage from municipal solid waste combustor ash land disposal facilities. Proposed Minn. Rules pt. 7035.2885, subpart 6, requires compliance with Minn. Rules pt. 7035.2815, subpart 2 which states that a land disposal facility must be located only in an area where the topography, geology, and ground water conditions allow the facilities to be designed, operated, constructed, and maintained in a manner that minimizes environmental impacts. Therefore, unless the owner or operator provides engineered secondary containment, a waste combustor ash land disposal facility must be located where factors which serve to attenuate pollutant migration are present.

Review of literature in addition to that sited in the Solid Waste SONAR also provides a basis for believing that metals and other contaminants contained in leachate which leaks through an ash disposal facility liner will be attenuated to a significant degree (References 14 to 21). For example, Quigley et al discusses a 15-year-old domestic waste land disposal facility where samples were taken of the natural clay soils beneath the facility. Analysis showed that chemical migration of essentially non-retarded species such as chloride and sodium had proceeded to a depth of 1.5 meters (approximately 4.5 feet) in 15 years, whereas heavy metals migrated only 0.1 meter (approximately 3.5 inches) (References 14 to 18).

Minimal migration of metals in sanitary landfill leachate was also predicted by Doran and Thresher using soils data and computer modeling techniques. Their paper concludes that arsenic, barium, lead, mercury, selenium, and silver concentrations would not be detectable at the compliance boundary. Cadmium and chromium also decreased in strength be a factor of ten or more (Reference 19). The leachate quality assumed for the model is within the range of leachate quality reported for Minnesota ash monofills (Appendix III). The assumed

leachate pH of 7.0 is fairly similar to ash leachate pH which ranges from 7.0 7.8, averaging around 7.5.

It may be stated based on review of literature on the subject and basic soils science principles that attenuation is dependent on the element and the speciation of the element, as well as the type and condition of the soils that leachate passes through (e.g., a reduced montmorillinite clay versus an oxidized silty sand) (References 19, 20 and 21). For example, Hasset et al. found that overburden sediments in the surface mining area of western North Dakota have a strong capacity to buffer pH and attenuate arsenic, selenium, iron and cadmium leached from coal combustion wastes. In excess of 99 percent of the iron and approximately 90 percent of the cadmium was removed from leachate by soils. Selenium was attenuated by 0 to 90 percent, which was less than the degree of attenuation for arsenic. Attenuation of both arsenic and selenium decreased as the alkalinity of the experiment increased (Reference 20).

In light of this, staff considered using different attenuation factors to set the maximum leachable contaminant level for each parameter. However, because the variation between parameters in degree of attenuation is dependent on soil and leachate characteristics, which vary between land disposal facilities, staff selected one attenuation factor which has been applied equally to all parameters. In different situations this factor is expected to be adequate for some parameters and very conservative for others.

Considering the evidence discussed above, it is estimated that attenuation may be expected to retard migration of pollutants such as heavy metals at a typical municipal solid waste ash land disposal facility. Because of the large number of factors which affect attenuation, it is difficult to calculate a specific number to use as basis for determining maximum leachable contaminant levels. The conclusion of the Solid Waste rules SONAR that toxic metals such as cadmium, lead and mercury are expected to be completely held within the liner corresponds to an attenuation factor equal to infinity. This is obviously inappropriate. Staff have therefore selected a more moderate number. A factor of 40 corresponds to a 97.5 percent reduction in leachate strength due to attenuation. (1/40 = 0.025; 100 percent - 2.5 percent = 97.5 percent). The maximum leachable contaminant levels have been established based on this factor in conjunction with the dilution factor of 1.5. Altogether then the ground water performance standards (which equal one-fourth the RALs, as discussed

above) have been multiplied by 1.5 and 40 for a cumulative factor of 70 times the ground water performance standards, or 60/4 = 15 times the RALs. Fifteen times the RALs falls within the range of reasonable choices identified under general considerations above.

6. Subpart 6. Location.

This subpart identifies standards which apply to locating municipal solid waste combustor ash land disposal facilities by referring to two parts of the Solid Waste rules. Minn. Rules pt. 7035.2555 sets out general locational standards for all solid waste facilities. It prohibits locating a facility in a flood plain, within certain shore land areas, wetlands, or a location where emissions of air pollutants would violate ambient air quality standards. Minn. Rules pt. 7035.2815, subpart 2 applies to municipal solid waste land disposal facility. Item B of subpart 2 states that a land disposal facility cannot be located in an area where the hydrologic or topographic conditions would allow rapid or unpredictable pollutant migration, impair long-term integrity of the facilities, or preclude reliable monitoring, unless an engineered secondary containment system is provided. Staff considered adding ash treatment to reduce contaminant leachability as another engineered system which would meet the requirements of the subpart. However, because of the difficulty of ensuring without a doubt that a treatment method will be effective for an indefinite period of time, this was not added.

The attenuation capacity of a site may be evaluated by comparing the quantity of pollutants which may be expected to seep into the liner based on leakage rate and leachate quality to the total cation exchange capacity of soils located between the fill area boundary and the compliance boundary. The comparison should consider the cumulative effect of each different soil type which occurs along the expected leachate migration path. This type of calculation was used by NSP as part of its engineering report justifying the location and design of the NSP Red Wing RDF ash land disposal facility.

7. Subpart 7. Hydrogeologic Evaluation.

The requirements of Minn. Rules pt. 7035.2815, subpart 3 are referred to without modification. The same steps for evaluating the hydrogeology of a mixed

municipal solid waste land disposal facility apply to evaluation of a municipal solid waste combustor ash land disposal facility. Referring to Minn. Rules pt. 7035.2815, subpart 3 rather than repeating it is reasonable because it is then clear to readers of the ash rules who are familiar with Minn. Rules pt. 7035.2815 that requirements for performing hydrogeologic evaluations are the same. Also, the length of this part would unnecessarily add a significant number of additional pages to the ash rules.

8. Subpart 8. Ground Water Performance Standards.

This subpart refers to Minn. Rules pt. 7035.2815, subpart 4, without modification. It is reasonable to apply the same standards, including establishment of a compliance boundary and intervention limits, to municipal solid waste combustor ash land disposal facility. The existing intervention limits include limits for parameters which are particularly of concern for municipal solid waste combustor ash land disposal facility, such as cadmium, lead, and other toxic inorganic parameters as well as 2,3,7,8-tetrachlorodibeno-p-dioxin (-TCDD). By referring to this part, changes to the intervention limits, which may occur as changes are made in the recommended allowable limits for drinking water, will automatically apply to municipal solid waste combustor ash land disposal facility.

9. Supbart 9. General Design Requirements.

This subpart refers to items A, B, D, E, F and G of the requirements of Minn. Rules pt. 7035.2815, subpart 5. Item A of subpart 9 of the ash rules replaces item C of Minn. Rules pt. 7035.2815, subpart 5. Item A modifies the requirements of Minn. Rules pt. 7035.2815, subpart 5, item C by adding to the list of points which the Commissioner must consider when reviewing a request for a shorter distance between the fill area and property boundary. Control of fugitive dust emissions at ash land disposal facility is an important part of providing environmental protection. Reference 4 states that "properly designed, operated and maintained land disposal facility means inclusively that emissions of fugitive dusts from the facility shall be held to negligible levels." Dust from waste combustor ash is likely to contain higher levels of toxic contaminants like lead and cadmium than dust from municipal solid waste.

Therefore it is reasonable to apply more stringent restrictions for dust control in these rules.

Item B of this subpart is identical to item H of Minn. Rules pt. 7035.2815, subpart 5, except the numbers of the subparts which are referred to have been changed to accurately reflect the numbering of this part.

10. Subpart 10. Cover Systems.

This subpart is very similar to part 7035.2815, subpart 6. Changes have been made which recognize the different physical properties of municipal solid waste combustor ash as compared to municipal solid waste.

Item A requires that intermittent cover be placed over all exposed areas on a schedule specified in the operations manual for the site. The minimum frequencies for intermittent cover frequency are specified based on the type of ash and moisture content of the ash. The basis for these requirements is established in a Agency position paper on control of ash dust emissions (Appendix IX).

Item B requires that intermediate cover be placed over ash where no additional ash will be placed within 30 days. This requirement is the same as that applied to municipal solid waste land disposal facility. Staff considered modifying this item to require that if soil is used as intermediate cover it must have a high hydraulic conductivity. The benefit of this would be that intermediate cover soil could then act as part of the leachate collection system if its permeability was greater than ash permeability. Making the soil the preferential pathway for leachate to travel through reduces the amount of ash which leachate comes in contact with as it travels through the land disposal facility, which may reduce the strength of the leachate. On the other hand, highly permeable soils are less likely to reject precipitation through evaporation than other soils, increasing the percentage of precipitation which becomes leachate. Also, keeping ash at its saturation point may slow the rate of leachate generation. Considering all these factors, staff has chosen not to change this requirement.

Item C requires placement of final cover over a municipal solid waste combustor ash land disposal facility. As required for municipal solid waste land disposal facilities, the final cover must consist of three layers: a barrier layer, a drainage layer, and a top layer. However, the requirements of

subitem (1) pertaining to use of soil barrier layers differ from those required by Minn. Rules pt. 7035.2815, subpart 6 in three main ways. First, the minimum permeability of the barrier layer must be no greater than $1x10^{-6}$ cm/sec, as opposed to $2x10^{-6}$ cm/sec as required by Minn. Rules pt. 7035.2815. It is reasonable to expect that a greater density may be achieved when compacting the barrier layer over a waste combustor ash monofill than when compacting soil over a municipal solid waste land disposal facility because ash, which in many ways is similar to structural fill, is much more stable than the spongy quality of municipal solid waste. This spongy nature of municipal solid waste is identified in the Solid Waste SONAR as the reason the maximum permeability of the final cover barrier layer may be greater than that of the base liner barrier layer (Appendix XIX).

Secondly, unless the barrier layer is compacted to a permeability no greater than $1x10^{-7}$ cm/sec, and the Commissioner approves otherwise, the top layer must be at least 42 inches thick (including at least 6" of topsoil). Subitem (1) designates two different minimum depths for cover soils above the drainage layer: 42 inches for clay compacted to between $1x10^{-6}$ and $1x10^{-7}$ cm/sec, and 18" for clay which is compacted to a permeability less than $1x10^{-7}$ cm/sec. It is desirable to protect the clay barrier layer from freezing because it has been established that the water between the clay particles in a clay barrier layer expands as it becomes frozen, increasing the distance between clay particles and hence the overall permeability (Appendix XX). Also, according to reference 23, "generally the thickness of a cap should be greater than the greatest frost penetration depth in order that the surface water drainage system is constantly operative; beyond this restriction, the soil-cover thickness should vary in accordance with the protection needed against infiltration and intrusion."

Third, this subpart allows use of compacted ash or other waste as the lower 18" of the barrier layer. The Agency believes it is reasonable to allow an applicant to propose use of a waste as part of the final cover barrier layer if they can prove that the waste will function as well as or better than soils, including maintaining its integrity at least through the postclosure period. The waste layer must also be capable of fusing with the upper six inch nonwaste layer to prevent a horizontal conduit from forming at the interface. Compacted ash which meets the permeability and structural integrity requirements of this part may therefore be proposed and considered as an alternative to soils. The

top six inches of the barrier layer must not be made of waste to prevent water which moves through the drainage layer along the barrier from transporting contaminants to the environment, since such run-off water is often discharged to surface waters. It should be noted that it is not acceptable to use waste as part of the liner barrier layer; this only applies to final cover barrier layers.

Subitem (2) requires taht synthetic membrand liners comply with the requirements of Standard Number 54 as is issued by the National Sanitation Foundation. Compliance with specifications of this document, which is incorporated by reference in part 7035.0605, is also required by part 7035.2815, subpart 6, except the date has been revised (Exhibit VI).

Subitem (3) establishes design requirements for facilities which exceed the maximum leachable contaminant levels. This design is in accordance with EPA guidance for hazardous waste land disposal facilities, with the exception of the depth of the drainage layer, which has been left at six inches as required by subitems (1) and (2). Based on results of the HELP model (Exhibit V), six inches appears adequate for conveying water off the facility, particularly considering the minimum permeability requirements and depth of overlying soil, including 12 inches of topsoil, which will reject the majority of precipitation through evapotranspiration. EPA guidance requires at least 24" of 1x10-7 cm/sec clay, minimum synthetic membrane thickness above clay of 20 mils, and cover and topsoil layer thickness of at least 24" (Reference 23).

Subitems (1) to (3) all require that the barrier be protected from vegetative roots and burrowing animals. According to Reference 24, it is possible that the geomembrane can be penetrated by burrowing animals, however, this may be prevented by use of a rock layer above the drainage layer. Also, synthetic membranes may be designed to be unappealing to burrowing animals. Therefore, compliance with this requirement, which is needed to maintain integrity of the final cover, is feasible and reasonable.

11. Subpart 11. Liners.

This subpart requires that all municipal solid waste combustor ash land disposal facilities be lined. The requirements for liners installed in municipal solid waste combustor ash land disposal facilities are presented.

Items A to K of this subpart and items B, C, F, G, I, K, L, M and N of part 7035.2815, subpart 7, apply to liners at all facilities. Item L applies only to facilities which dispose of bottom ash, item M applies only to land disposal facility which dispose of combined bottom and fly ash, and item N applies only to facilities which dispose of fly ash which does not exceed the maximum leachable contaminant levels. Item O applies to facilities which accept ash (bottom ash, fly ash or combined ash) which exceeds the maximum leachable contaminant levels. Item P applies to facilities which accept ash which exceeds the "maximum concentration of contaminants for characteristic of extraction procedure (EP) toxicity" established in Minn. Rules ch. 7045.0131, subpart 8, most commonly known as the "hazardous waste limits."

It is reasonable to require that all municipal solid waste combustor ash land disposal facilities be lined because municipal solid waste combustor ash has the potential to leach toxic contaminants (see Background, part II of this document).

In writing this subpart Agency staff considered repeating the requirements of part 7035.2815 which apply to waste combustor ash land disposal facilities. However, staff chose instead to refer to applicable items rather than repeat them to make it clear to persons who are also familiar with part 7035.2815, subpart 7, which of the requirements are the same for ash facilities.

Item A requires that an ash monofill be separated from a municipal solid waste or other land disposal facility to prevent exposure of ash to leachate from other sources. This is necessary to minimize the leaching potential of waste combustor ash. As discussed in previous parts, waste combustor ash has a higher potential to leach contaminants if it is exposed to acidic leachate from municipal solid waste.

Item B is identical to part 7035.2815, subpart D except for the addition of subitem (2). Subitem (2) states that a secondary liner and leachate collection and detection system must be installed between the subgrade and primary liner if the requirements of items O or P apply. Items L, M and N, which apply to bottom ash, combined ash and fly ash, respectively, which do not exceed the maximum leachable contaminant levels, do not require installation of a secondary liner and leachate system. The remainder of the subitems are repeated because they assist the reader in understanding this subpart.

Item C is identical to a requirement contained in the opening paragraphs of

part 7035.2815, subpart 7. Because these paragraphs have not been referenced, it is necessary to repeat applicable requirements such as this.

Item D is basically the same as part 7035.2815, subpart 7, item B, which is discussed on pages 449 to 450 of the Solid Waste SONAR (Appendix XVIII). It has been slightly modified to emphasize the importance of compatibility of the liner system with municipal solid waste combustor ash. The compatibility of a liner and leachate may be determined using EPA Method 9090 (Reference 24).

Item E requires that synthetic membrane liners be at least 60 mils (60/1000 of an inch) thick. Synthetic membranes must also comply with the specifications of the National Sanitation Foundation, Standard Number 54, Flexible Membrane Liners, May 1990 revision. In this document the National Sanitation Foundation has compiled up-to-date specifications and guidance regarding the selection of appropriate liner strengths and materials. Because a number of products exist which may be appropriately used as ash monofill liners, including high density polyethylene (HDPE) and potentially linear low density and very low density polyethylene (LLPDE and VLDPE), (Reference 24) and others which are not recommended for use in land disposal facilities, it is reasonable to incorporate this document by reference to ensure that synthetic liners which will perform as intended are designed and constructed.

Part 7035.2815, subpart 7, item E requires that synthetic membrane liners be 60 mils for unreinforced membranes, and 30 mils for reinforced membranes. However, staff has received a recommendation against allowing 30 mil reinforced liners because:

1. Reinforced liners are made of 12 mil of liner, 12 mil "scrum" in the middle for strength, and 12 mil on the bottom, rather than being solid thickness like a 60 mil HDPE liner. The scrum will not elongate, so if the liner is put under tensile stress, the scrum breaks, and/or the layers peel apart.

2. These liners are typically used for roof installations (90+ percent of applications), and do not have a proven track record as landfill liners (Reference 25).

All synthetic membrane liners used to date in Minnesota as the base liner for ash and municipal solid waste land disposal facilities have been 60 mil HDPE. 30 mil reinforced membranes have not been used. Therefore, it appears that if this trend continues, this requirement will not impose a greater burden on the regulated community.

It should be emphasized that 60/1000 inch is the minimum acceptable thickness. In some situations a thicker liner may be needed to withstand forces which may tear a minimum acceptable liner. The required thickness may be estimated using applicable equations which take into account the direction and magnitude of forces acting on the liner (Reference 24). For example, an ash land disposal facility in which ash is placed to a depth greater than 100 feet may need to consider use of a thicker membrane, depending on the potential for subsidence of the subbase or other factors which place stresses on the liner.

Item F simply notifies the reader that requirements for construction and construction certification are found in subpart 14 and part 7035.2610. It is important that a facility be constructed in accordance with the facility design which is reviewed by Agency staff to determine compliance with this part. Therefore, it is prudent and reasonable to refer in this subpart to these related requirements.

Item G specifies an action which is routinely performed as part of proper installation of synthetic membranes. Maintaining good contact between the synthetic and clay components of a composite liner system results in great liner efficiency than maintaining a composite liner with poor contact (Reference 26).

Item H is similar to a portion of part 7035.2815, subpart. 7, item F. A description of the desirable characteristics of drainage soils has been added. It is important that the proposer and Agency staff who review permit applications consider the quality of the stones to be used in a drainage layer to ensure that it will operate as designed. Selection of an appropriate drainage material is especially important when the material will be placed directly over a synthetic membrane, which must be carefully protected from being punctured. Because synthetic membrane liners are required for all ash monofills, without the option to construct a clay-only liner as allowed for mixed municipal solid waste land disposal facilities, it is reasonable to place special emphasis on this within these rules. Compliance with this item may be achieved through use of a rounded stone material which is poorly graded (i.e., consists of primarily one stone size) and does not contain organic matter, soft sandstone or other rocks that can break down into smaller pieces, or other materials which may clog the drainage layer. This type of material is also most likely to comply with the minimum permeability requirements of part 7035.2815, subpart 7, item F, which, also applies to waste combustor ash land disposal facilities.

Item I requires that owners or operators design and construct liners with the minimum necessary number of points where the liner is penetrated by pipes which are part of the leachate collection system. Some land disposal facilities are designed such that leachate drains toward one or more low points where it leaves the lined area by gravity flow through pipes which have been inserted through the lined sidewalls. To prevent the area around the pipe from acting as a hole where leachate may escape, a sealed "boot" is constructed around the pipe using welded pieces of synthetic membrane liner. Other facilities collect and remove leachate using a piping system which is entirely within the lined area. Such systems pump leachate to an elevation above the lined sidewall for removal. This item encourage use of the latter design because, although pipe boots work well in many cases, a pipe boot and the liner around it may become subject to tearing forces if differential settlement occurs between the pipe and disposal area (Reference 26). Also, it is good practice to minimize the amount of liner which must be welded. Because compliance with this item simply requires that owners or operators follow good design practices, and the term "minimize" is used, this item does not place an extra burden on owners and operators.

Item J is the same as part 7035.2815, subp. 7, item J, without the specific liner efficiency. Rather, this item refers to items L through P, which specify varying liner efficiencies, depending on the type of ash to be disposed of and whether the ash exceeds the maximum leachable contaminant levels.

Item K is nearly identical to part 7035.2815, subpart 7, item L. The first sentence has been changed to properly identify the location within the rules where an engineering report is required for a waste combustor ash land disposal facility. Subitems (2) and (3) have been modified to account for differences in waste and leachate characteristics between municipal solid waste and ash, such as the alkaline nature of ash leachate.

Items L to P all require that ash monofills use a composite liner. Part 7035.2815, subpart 7, allows mixed municipal solid waste land disposal facilities to be constructed using either a composite liner or four or more feet of clay compacted to 1×10^{-7} cm/sec or less. However, this part does not include clay-only liners as an option for waste combustor ash monofill liners constructed in the future because there is evidence that liquid containing high concentrations of monovalent cations increases the permeability of compacted clay. Reference 27 states:

> Many investigators have presented laboratory test results that show when clay is subjected to high concentrations of monovalent cations or

when multivalent cations are introduced into a paramount solution, the fluid conductivity of the clay increases. These increases are a result of ion exchanges, which cause the soil fabric to expand and become more porous.

Soils scientists at the MPCA have confirmed this. It should be noted that other constituents often found in waste combustor ash leachate, such as sodium, may actually decrease clay permeability by causing clay particles to flocculate. That is, the clay particles attempt to move further from each other. When this occurs in a situation where the clay is confined a less permeable liner results. However, because it is difficult to predict leachate quality precisely, and consequently which clay reaction is most likely to take place, Agency staff has taken a conservative position and has required that clay-only liners not be allowed in the future for ash monofills (References 22, 28,and 29).

This part, by not allowing clay-only liners for ash monofills, is not necessarily being more restrictive than 7035.2815. Subpart 7, items B and C, require that the liner be compatible with the waste and maintain its integrity for the operational and postclosure life of the facility. Because ash is considered incompatible with clay, clay-only liners would not be allowed under part 7035.2815.

Staff considered allowing clay-only liners for bottom ash disposal facilities, but the levels of chlorides and sulfates in bottom ash found using the Method 1312 leach leach test are often as high as those found in combined ash, sometimes higher. Therefore a clay liner may also be undesirable for use in a bottom ash land disposal facility.

Figure 7 shows cross sections of the different liners required by items L through P. Table 5 presents a written summary.

Item L presents the minimum design requirements for a land disposal facility which disposes of bottom ash and does not accept any fly ash. After January 1, 1993, this item only applies to ash which does not exceed the maximum leachable contaminant levels. There is only one difference between this required design and that presented in item M for combined ash: one foot of compacted clay rather than two feet is required beneath the synthetic liner. The efficiency of the liner and final cover must still equal the minimum standards required for combined ash. The purpose of the clay portion of a composite liner is to plug holes in the synthetic membrane, retard migration of leachate which leaks through the membrane, and attenuate metals through cation exchange. Agency staff has specified one foot of clay for bottom ash facilities

TABLE 5: SUMMARY OF DESIGN REQUIREMENTS FOR MUNICIPAL SOLID WASTE COMBUSTOR ASH LAND DISPOSAL FACILITIES

	Bottom Ash	Combined Ash	Fly Ash
Before 9 months after effective date of rules	Temporary Program applies	Temporary Program applies	Temporary Program applies
More than 9 months after effective date, before January 1, 1993	Liner: leachate collection, FML over 1' clay Final Cover: FML + 24" soil or clay + 48" soil[a]	Liner: leachate collection, FML over 2' clay Final Cover: FML + 24" soil or clay + 48" soil	same as after January 1,1993
After January 1, 1993			
(1) Leachate[b] MLCL	Liner: leachate collection, FML over 1' clay Final Cover: FML + 24" soil or clay + 48" soil	Liner: leachate collection, FML over 2' clay Final Cover: FML + 24" soil or clay + 48" soil	Liner: leachate collection FML over 3'clay Final Cover: FML + 24" soil or clay + 48" soil
(2) MLCL < Leachate < HWL	Liner: 2 FML w/ leachate collection above and between over 2' clay Final Cover: 48" soils over FML over 2' clay	Liner: 2 FML w/ leachate collection above and between over 2' clay Final Cover: 48" soils FML over 2' clay	Liner: double composite w/ 2' of clay below FMLs Final Cover: 48" soils over FML over 2' clay
(3) Leachate > HWL	Liner: double composite Final Cover: 48" soils over FML over 2' clay	Liner: double composite Final cover: 48" soils over FML over 2' clay	Liner: double composite Final Cover: 48" soils over FML over 2' clay

Abbreviations:

MLCL = Maximum Leachable Contaminant Levels (established in part 7035.2885, subpart 5)

HWL = Hazardous Waste Limits (from Minn. Rules part 7045.0131, subpart 8)

FML = Flexible Membrane Liner

a Final cover soils overlying the specified barrier layer include 6" of topsoil and 6" of high permeability drainage soils.

b Leachate means results of ash laboratory testing or actual ash monofill leachate, as provided by part 7035.2885, subpart 4, items A to C.

ASH DISPOSAL FACILITY LINER REQUIREMENTS

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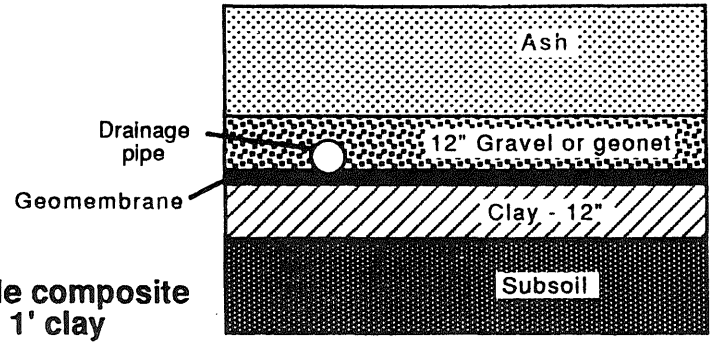
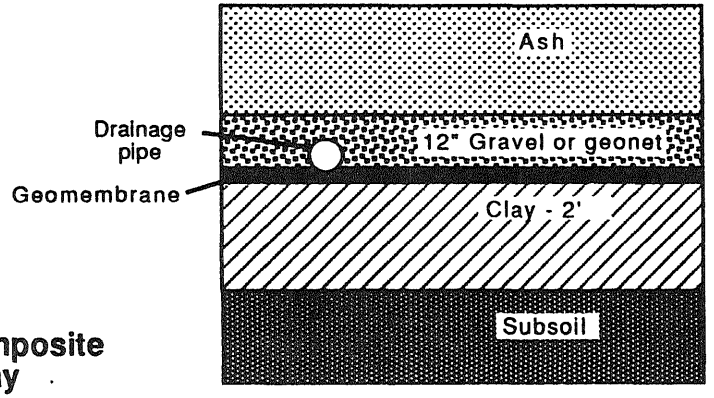
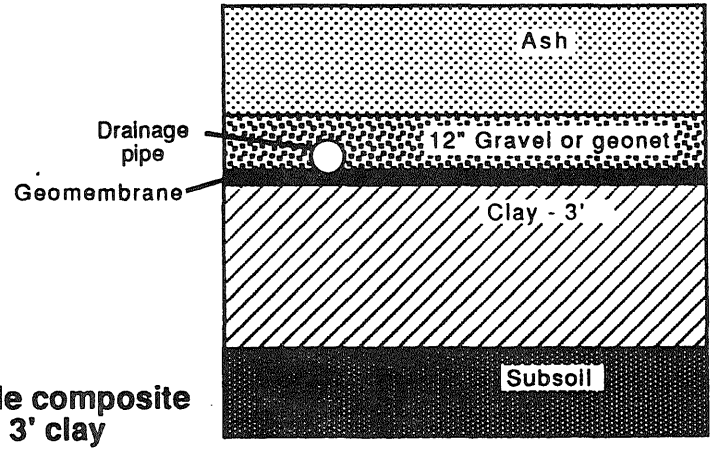


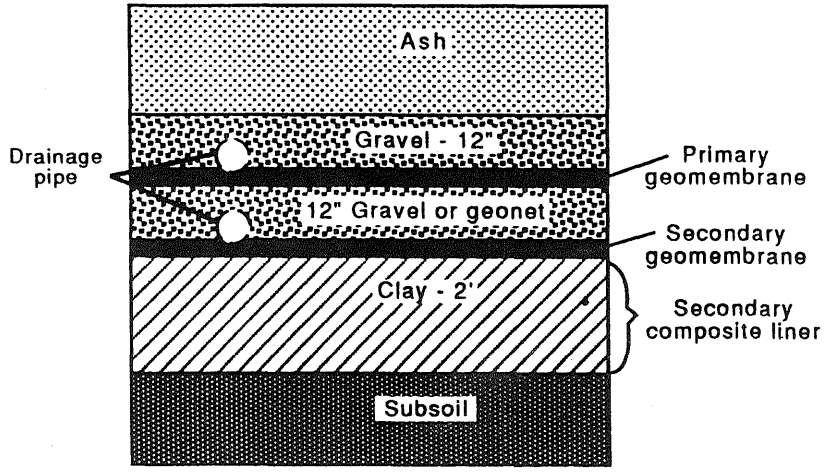
A. Single composite liner, 1' clay



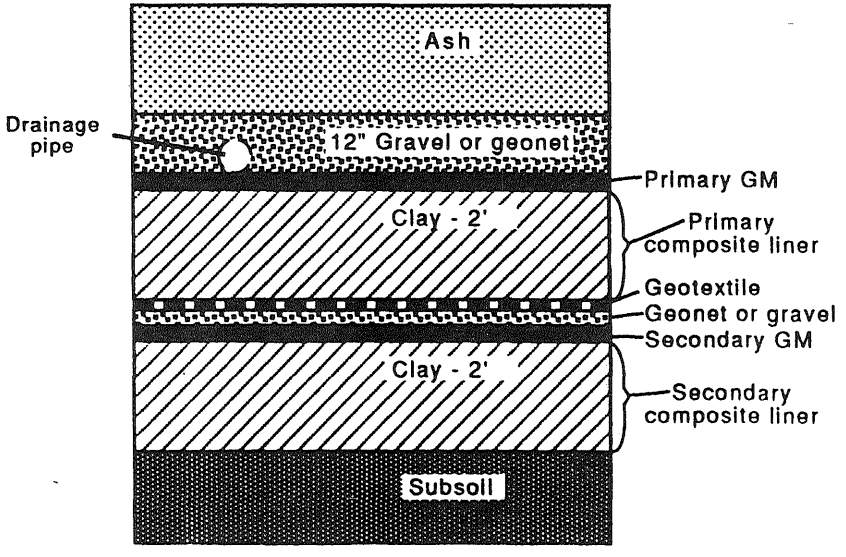
B. Single composite liner, 2' clay



C. Single composite liner, 3' clay



D. Single geomembrane, single composite liner



E. Double composite liner

because: 1) bottom ash contains and leaches lower levels of metals than combined ash, as shown by results of ash testing performed under the Temporary Program (Appendix XI), and 2) the clay will still act as an impediment to leachate flow through holes in the synthetic membrane. Because the metal content of bottom ash is lower, the quantity of clay needed to attenuate metals is less than that required for combined ash or fly ash. Also, as noted in Appendix II, it is the Agency's goal to encourage separate management of bottom and fly ash. Specifying a design for bottom ash which is less stringent and therefore less costly than that required for combined ash complies with this Agency's goal while still providing adequate environmental protection.

Item M presents the design standards for a facility which disposes of combined bottom and fly ash. After January 1, 1993, the ash disposed of in a facility designed in accordance with this part may not exceed the maximum leachable contaminant levels. The requirements identified in this item are identical to those specified by part 7035.2815, subpart 7, for mixed municipal solid waste land disposal facilities. Leachate from waste combustor ash land disposal facilities appears is of equal or better quality than leachate from mixed municipal solid waste (MSW) land disposal facilities, based on data showing that ash leachate contains the same or lower levels of toxic metals and much lower levels of volatile organic compounds than MSW leachate (Appendices III and XIV). Therefore, it is reasonable to apply the same minimum design standards to waste combustor ash land disposal facilities as those applied to MSW land disposal facilities through part 7035.2815. The reasonableness of those standards is set out in the Solid Waste SONAR, pages 429 to 464 (Appendix XVIII).

Item N presents the minimum design requirements for a land disposal facility which disposes of fly ash. If necessary to comply with part 7035.2565 this item may also be applied to a land disposal facility which accepts predominantly fly ash along with a small amount of bottom ash. After January 1, 1993, this item only applies to ash which does not exceed the maximum leachable contaminant levels. There are three differences between this design and that required for combined ash. First, three feet of compacted clay rather than two feet is required beneath the synthetic liner. The reasons for this are the same as those discussed above under item L regarding liners for bottom ash disposal facilities, except that in this case fly ash typically contains and leaches higher levels of metals than combined ash (Appendix XI).

The liner and final cover efficiencies specified in subitems (2) and (3) also differ from those required for combined ash in item M. The minimum efficiency of the liner system by itself must be at least 98 percent for a fly ash land disposal facility, as opposed to 95 percent as required for combined ash facilities. The efficiency of the liner system in combination with the cover system must achieve an overall site efficiency of at least 99.5 percent, as opposed to 98.5 percent. Greater liner efficiency decreases the potential for ground water contamination. Fly ash contains, in total content, higher levels of contaminants than that found in combined ash, including much higher levels of toxic heavy metals such as lead, cadmium and mercury, as well as higher levels of contaminants such as chlorides, sulfates and sodium. Even if fly ash is treated to reduce contaminant mobility, the contaminants are still present in the ash. In case the treatment applied were to lose its effectiveness, it is prudent to place the ash in a disposal facility with a high efficiency. Also, some treatment processes may decrease the leaching potential of the parameters for which maximum leachable contaminant levels have been set without decreasing the leaching potential of other parameters, such as aluminum or sodium, which at may be present at high enough levels to cause significant ground water contamination. A composite liner system may be designed which meets these efficiency requirements. In fact, it is likely that many combined ash land disposal facilities will also meet these required efficiencies.

It should be noted that this part never applies to fly ash which exceeds the maximum leachable contaminant levels. The January 1, 1993, deadline only applies to bottom ash or combined ash land disposal facilities. Fly ash which exceeds the maximum leachable contaminant levels may only be land disposed in a facility which complies with item P, that is, it must meet state-of-the-art hazardous waste land disposal facility design requirements. It is reasonable to promulgate more stringent standards for fly ash because it has been shown to typically contain much higher levels of contaminants than combined ash. Fly ash tested using the Extraction Procedure (EP) Toxicity test, the leach test which preceded the TCLP as a test used to classify wastes as hazardous or nonhazardous, nearly always exceeds the hazardous waste limits (Appendix XIII and Attachment 2 to Appendix V). Even when tested using Method 1312, a less aggressive leach test, fly ash often exceeds the hazardous waste limits (Appendix XI). Because there currently are no fly-ash-only land disposal

facilities, it is not a burden to require compliance with this item or item P, whichever applies, immediately upon the effective date of the proposed rules.

Based in data collected under the Temporary Program (Appendix XI) it appears that untreated fly ash from most facilities would exceed the maximum leachable contaminant levels. Because the cost of constructing a facility which complies with item P is much more than the cost of a facility which complies with this item, the rules encourage treatment of fly ash before it is placed in a land disposal facility. This is a more reasonable approach than requiring that in all cases fly ash be treated prior to disposal, because fly ash from some facilities may not contain high levels of metal and other contaminants. For example, the Western Lake Superior Sanitary District (WLSSD), which combusts RDF, sludge and sometimes wood chips, produces fly ash which contains lower levels of contaminants than bottom ash.

As noted above, fly ash land disposal facilities must either comply with this item or item P. Item O, which specifies design requirements for bottom ash or combined ash which exceeds the maximum leachable contaminant levels but does not exceed the hazardous waste limits, does not apply to fly ash. Agency staff believe that in most cases either fly ash will meet the maximum leachable contaminant levels inherently or through treatment, or fly ash will exceed both the maximum leachable contaminant levels and the hazardous waste limits. Agency staff believe that fly ash which falls between the maximum leachable contaminant levels and the hazardous waste limits has demonstrated the potential to leach contaminants. Because of the high total concentration of contaminants typically present in fly ash, Agency staff are concerned that ash which leaches over the maximum leachable contaminant levels may have the potential to leach large amounts of contaminants over time. Therefore the rules have been established with only two allowable design standards for fly ash land disposal facilities.

Item O presents the requirements for bottom ash and combined ash land disposal facilities which accept ash which exceeds the maximum leachable contaminant levels established under subpart 5. The minimum liner design requirements specify use of a composite liner under a leak detection and secondary leachate collection system, overlain by a primary synthetic membrane liner overlain be the primary leachate collection system. The efficiency of this design falls between the efficiency of a composite liner alone and that of a double composite liner.

This design is identical to the synthetic membrane/composite double liner system for a landfill discussed in Reference 30. Although double composite liners are considered to be the most recent minimum technology requirement for hazardous waste disposal facilities, double composite liners are considered unnecessary for this application, considering that data on leachate quality at ash monofills have not exceeded hazardous waste limits.

Alternative designs for double-lined waste impoundments are also discussed in "Evaluation of Landfill Liner Designs" by P. Schroeder, et al., (Reference 23). According to this reference liner design E, consisting of a primary leachate collection system, a synthetic membrane liner, a secondary leachate collection system, and a composite liner, as required by this item, is predicted by the HELP TWO model to be as efficient as a double composite liner in preventing migration of leachate to the general environment beneath the liner. It is also predicted to have the same performance as a similar liner in which the composite liner is used as the primary liner, and a synthetic membrane liner is used as the lower liner. However, as noted by Schroeder, the former design is much more likely to detect leakage through the primary liner than the latter system, and therefore is preferable.

Another benefit of using the composite liner as the secondary liner is that compacting a clay layer which begins only 12 inches above a synthetic membrane liner may be avoided. Because compaction of the clay layer may increase the potential for puncture or tearing the synthetic membrane liner, avoiding compaction of clay above a synthetic membrane liner is desirable.

Finally, the secondary liner must be capable of efficiently collecting leachate under low head conditions. The collection efficiency of a composite liner under these conditions is much greater than that of a clay-only liner.

Item P specifies the design requirements for land disposal facilities which dispose of fly ash which exceeds the maximum leachable contaminant levels or bottom ash or combined ash which exceeds the hazardous waste limits. The design specified is a double composite liner, that is, two composite liners with a leachate collection system above each liner. As noted above, such a design complies with the most recent EPA minimum technology requirements for hazardous waste disposal facilities, with the possible exception of the depth of compacted clay used as part of each composite liner. This item specifies at least two feet of compacted clay, whereas three feet has been specified by some references as the desired depth of clay. However, Agency staff believes that two feet of

clay is capable of satisfying the functions of the clay layer in the case of an ash monofill, including retarding the rate at which leachate which escapes through holes in the synthetic liner migrates and attenuating the movement of pollutants contained in the leachate.

Very high efficiencies are required by items O and P. These efficiencies are justified because ash which must comply with these items has the potential to leach contaminants at levels which may cause ground water pollution if the land disposal facility is not equipped with an extremely efficient liner and final cover system, as discussed earlier in this document regarding establishment of the maximum leachable contaminant levels (subpart 5).

12. Subpart 12. Cover and Liner Materials Evaluation.

This subpart requires compliance with part 7035.2815, subpart 8, which lists the soil properties and appropriate analysis methods required for evaluating soils used as part of the facility liner or final cover system. Although the specifications which soils used at an ash monofill must meet may differ from those used at MSW land disposal facilities, the methods used for testing soils are the same. Therefore the applicable portion of part 7035.2815 has been referenced. By referring to that part rather than repeating it, it is obvious to the reader that the standards have not been changed.

13. Subpart 13. Leachate Detection, Collection and Treatment.

This subpart requires that a leachate detection, collection and treatment system be designed in accordance with part 7035.2815, subpart 9. Because Agency staff proposes in these rules that leachate be managed as required by part 7035.2815, it is reasonable to refer directly to that part.

14. Subpart 14. Construction Requirements.

Subpart 14 includes two new requirements regarding construction of clay barrier layers. The majority of construction requirements with which ash land disposal facilities must comply are identified in part 7035.2815, subpart 12, incorporated by reference into this subpart. The first new requirements, item A, requires that soil barrier layers be compacted in lifts which are not deeper

that the feet on the compaction equipment, or 6 inches, whichever is less. This practice is called for by generally acceptable engineering specifications for liner construction. Page 451 of the Solid Waste SONAR provides explanation of the importance of compacting the full depth of each lift and fusing lifts together (Appendix XVIII). Creating a rule requirement which states this ensures that it will not be overlooked.

Item B requires that a clay barrier layer be bladed and rolled smooth after the final lift is compacted. The purpose of a barrier layer is to impede movement of liquid vertically by encouraging liquid to move laterally through a drainage layer along the surface of the barrier layer. If the surface of the barrier layer contains ruts which run across the flow path, liquid which is trapped by the ruts will move into the liner and the drainage system will not function optimally. Therefore, it is reasonable to require that the surface of the barrier layer be smooth before the drainage layer is placed over it. Although this is standard practice for many of the firms who construct land disposal facility liners and final cover systems, Agency staff has witnessed construction of numerous sites where the construction contractor considered the barrier layer construction complete, even though the clay had large numbers of deep ruts. This requirement applies to clay barrier layers used alone, as allowed for final cover by subpart 10, item C, subitem (1), as well as clay layers used directly below synthetic membrane liners. As noted regarding subpart 11, item G, it is important that close contact be maintained between the synthetic membrane and compacted clay. A smooth clay surface helps to create such close contact.

Item C requires that an inspector be present during construction of final cover systems and liners. The person must be qualified by training and experience in the area of constructing waste land disposal facilities or similar containment facilities. The person must be able to identify different soil types, and be familiar with soil testing procedures and interpretation of engineering plans. This requirement is reasonable because proper construction of land disposal facilities is vital to ensuring that they operate as designed. Even if a facility is very well designed, it will perform at an efficiency less than intended if it is not constructed in accordance with design specifications.

Unfortunately, persons hired to construct land disposal facilities are often more familiar road construction than disposal facility construction. They

may not be aware of the importance of certain design features, such as the slope of the liner base, and the need to properly work the soils to create low permeability liners and high permeability drainage systems. An inspector familiar with land disposal facility construction is able to observe and discuss matters with the contractors to make sure the facility is constructed as designed. Most engineering consultants who design land disposal facilities routinely use field inspectors. That person also fulfills other functions required by chapter 7035, such as preparation of construction certification documentation and, in some cases, performing soils testing. Therefore, this requirement does not impose an additional burden for most owners or operators. The additional expense this requirement imposes on owners and operators who have not hired on-site inspectors in the past is justified by the improved facility performance which may be expected, and consequently the decrease in potential for leachate releases which may require the owner or operator to take contingency actions.

15. Subpart. 15. Operation and Maintenance Requirements.

"The design and construction of a land disposal facility are only part of the measures needed to minimize the risks associated with the facility. Operations can enhance or impede the performance of a well designed and constructed facility," according to the Solid Waste SONAR at page 520. This statement applies equally as well to a waste combustor ash land disposal facility as to a municipal solid waste land disposal facility, and establishes the need for this subpart.

The majority of the requirements of this part are identical to requirements contained in part 7035.2815, subpart 13, exchanging the term "ash" for "mixed municipal solid waste." Rather than referring to applicable items of part 7035.2815, however, all applicable requirements have been repeated in this subpart for ease of reference by operating staff. Of the 23 items contained in 7035.2815, subpart 13, three items are not included in this subpart at all. This includes item H regarding tire storage, item N regarding disposal of dead animals, and item O regarding disposal of demolition debris. Because subpart 3 restricts the wastes which may be accepted at a municipal solid waste combustor ash land disposal facility to waste combustor ash and other wastes specifically

approved by the commissioner, these provisions do not apply to an ash land disposal facility.

Of the remaining items, those which have been substantially modified are discussed below.

Item A requires that a waste combustor ash land disposal facility be operated by a certified operator. Three types of operator certification exist. Type I, II and III operators are defined by parts 7048.0100 to 7048.1300, which provide that a Type III operator may operate a demolition or industrial land disposal facility, and Type II may operate a municipal solid waste land disposal facility. Type I certification is required for operation of a hazardous waste land disposal facility. No specific category currently exists for municipal solid waste combustor ash land disposal facility operators. Therefore, the proposed rules do not specify the type of operator certification required. At this time, waste combustor ash land disposal facility operators must be certified as Type III operators at a minimum. Because Type II training and certification goes into greater detail than Type III, a Type II operator is also considered qualified to operate a waste combustor ash disposal facility.

The Agency is considering modification of chapters 7048 and 7035 to better clarify what categories of certification are acceptable for facilities such as those which dispose of waste combustor ash. Some portions of the Type II training course are applicable to operation of a waste combustor ash land disposal facility, such as liner construction and leachate management. Other portions are less applicable, such as landfill gas control, and waste compaction techniques. To be certified as a Type II operator, a person must act as an operator at a municipal solid waste land disposal facility under the supervision of a certified operator for at least six months. Therefore, it is unreasonable to require Type II certification for a waste combustor ash land disposal facility operator, as the person would have to work at a municipal solid waste land disposal facility in order to obtain the needed certification.

Items B and C are intended to maximize the density of ash in the land disposal facility. This is desirable for a number of reasons. First, an ash monofill has much less potential for postclosure settling than a municipal solid waste land disposal facility because ash will not degrade with time and decrease in volume. Postclosure settlement may adversely effect the performance of the final cover system. To take complete advantage of this, it is necessary to

ensure that settlement does not occur due to poor compaction. Second, compaction may increase surface water drainage over ash to the sand drainage blanket rather than through the ash. Finally, better compaction allows a greater amount of ash to be placed in a given space, decreasing the size of the facility needed to dispose of ash generated over a certain period of time.

Item B requires that ash be spread and compacted in layers which are one foot or less in depth before compaction. Part 7035.2815 requires compaction of solid waste in layers which are two feet or less in depth. A thinner layer is required for ash for two main reasons. First, the rate at which ash arrives at a municipal solid waste combustor ash land disposal facility, which typically only receives ash from one waste combustor, is much more consistent and predictable than the rate at which waste arrives at a municipal solid waste land disposal facility, which may receive many truckloads over a short time. Therefore, the operator of an ash land disposal facility is better able to plan the working face size so that ash may be spread evenly in one-foot lifts, with time to compact the lift before the next shipment of ash arrives.

Second, the physical characteristics of ash are different than municipal solid waste. Municipal solid waste consists of a nearly infinite variety of constituents, many of which are larger than a soda can, whereas most incinerator ash is less than this size. Also, municipal solid waste contains many items which are difficult-to-compact, such as plastic bottles. Many of these difficult to compact items are combustible and are not found in waste combustor ash. Waste combustor ash is similar to a well-graded soil. Therefore, it is reasonable to apply soil compaction techniques rather than municipal solid waste compaction techniques. As noted above in discussion of barrier layer compaction, the depth of the layer should not be greater than the depth of compaction equipment feet. However, soil compaction in thin lifts requires use of special equipment which may not be available on site. Requiring purchase of a grader and sheeps-foot compactor for operation of a waste combustor land disposal facility would be an unreasonable cost burden, given that settlement may likely be avoided with moderate compaction, making maximum compaction unnecessary. Also, increased surface water run-off is only dependent on the compaction of the top few inches of the lift. One foot has been selected as a depth which is achievable with existing equipment, yet will attain the desired environmental benefits.

Compacting one foot rather than two foot lifts increases the amount of time needed to compact a given volume of ash by a factor of two. However, as discussed under the economic impact analysis, any increase in costs due to this requirement will likely be offset by savings due to increasing the amount of ash which may disposed of in each cell.

Item C requires that appropriate compaction equipment be used which will be adequate to prevent settlement. There are a number of different pieces of equipment which may be used to satisfy the requirements of this item, including a bulldozer, landfill compactor, static or vibratory smooth roller, vibratory padfoot and sheepsfoot compactors. In a lecture given at the Second International Conference on Waste Combustion on April 17, 1991, Taylor Eighmy of the University of New Hampshire reported the preliminary findings of a study designed to determine which of the equipment listed above achieved the greatest compaction of municipal solid waste combustor ash. The study showed that at the moisture content at which ash was attempted to be compacted (approximately 45 percent water), there was no difference in the compaction achieved by different equipment. However, if the moisture content of the ash was closer to the optimum for maximum compaction, which was found to be less than 45 percent, the researchers believe some equipment may perform better than others. Through this item the Agency encourages owners and operators to make conscious decisions regarding selection of compaction equipment. However, because of the lack of information regarding which specific type of equipment works best, a performance standard is given by requiring that compaction be adequate to prevent settlement.

Item D requires monthly testing of the moisture content of ash which is exposed. These data are necessary to determine compliance with subpart 10, item A, regarding maintaining a minimum ash moisture content and placing intermittent cover to prevent dust emissions. Sample collection procedures are specified to ensure that accurate data are collected. The goal of testing performed in compliance with this part should be to ensure that the moisture content of ash right at the exposed ash surface does not become low enough to allow dust to escape. Compliance with this item does not pose a significant burden on facility owners or operators. Moisture content analysis is relatively inexpensive. If samples are sent to a laboratory for analysis, a cost per sample of $10 or less may be expected (Appendix XXI). Monitoring may also be

done using an in-place moisture meter such as that used during construction to test the water content of soils. To maximize ash density, the owner or operator may choose to purchase a moisture meter for use in attempting to compact ash at the optimum moisture content for compaction.

Item E requires that ash be placed and compacted at a moderate slope. As noted above, it is desirable to promote surface water drainage off the ash. If the ash surface is not sloped, drainage cannot occur. Water will pond and eventually seep into and through the ash. However, the compaction achieved for a given compactive effort decreases as the slope of the surface being compacted increases. Therefore, the requirement of part 7035.2815, subpart 13, item B, has been modified to point out that sloping the ash surface to promote water drainage should not be done at the expense of compaction.

Item H requires that final cover be placed over each phase as soon as possible after it reaches final elevations. This is nearly identical to the requirement of part 7035.2815, subpart 13, subpart E, with the exception that the phrase "as soon as possible considering limitations such as weather conditions" has been added. Final cover cannot be placed at temperatures below freezing. The phrase is added to prevent an owner or operator from being out of compliance for reasons beyond their control.

Item I requires that each phase be outlined using grade stakes or another marking method before ash is placed in that phase. This helps ensure that location, slope and depth of the phase are in accordance with the approved engineering plans. A portion of the related requirement in part 7035.2815, subpart 13, item F which states that this action must be approved in accordance with subpart 12 is not included in the ash rules. Part 7035.2815, subpart 12, item A requires that the Commissioner be notified seven days before construction begins on major design features; approval by the commissioner is not required, making this a confusing requirement. Also, the solid waste rules require staking each phase in part to avoid past problems at municipal solid waste land disposal facility such as filling outside property boundaries. Problems such as this have not occurred at municipal solid waste combustor ash land disposal facility, where a much greater degree of sophistication of design and operation exists than that found in the past at problematic municipal solid waste land disposal facility. Therefore, Commissioner approval of this action is not needed.

Item J is similar to part 7035.2815, subpart 13, item G. At first blush this requirement regarding areas at a land disposal facility used for resource recovery may not seem applicable to a waste combustor ash land disposal facility. However, the Agency is aware of at least one land disposal facility which removes ferrous metals from ash prior to disposal at an on-site facility. The Agency believes such activities should be encouraged as recycling rather than landfilling is accordance with state policy. Also, removal of ferrous metal, which tends to be large pieces of ash, increases the density of remaining ash (Reference 3). The phrase "including but not limited to ferrous metal recovery" has been added to point out an example of a potential application for this requirement. Recovery operations are confined to areas approved in the facility permit to make clear that such activities may not occur without Agency approval. Agency review and approval must take into account design and operation requirements of part 7035.2995.

Item K is identical to part 7035.2815, subpart 13, item I, except that the facility must also be inspected for dust emissions. The basis for the remainder of the requirements is set forth in the Solid Waste SONAR. Dust emissions from a waste combustor ash land disposal facility must be prevented in accordance with subpart 10, item A, regarding intermittent cover, and 7035.2565, subpart 3. Monitoring ash moisture content is the main monitoring tool for determining if dust emissions are likely. Observation of dust emissions or evidence that dust has been carried from the ash fill area to adjacent ground is another tool for determining compliance. Because this requirement may be met through simple observation, it is not an increase in the burden of the regulations. In fact, the operator should be making observations to ensure that no dust is being generated by operations on a nearly continual basis.

If conditions exist that allow dust emissions, dust at an ash land disposal facility may be expected to contain higher levels of toxic contaminants than dust from an MSW land disposal facility. This statement is based on the fact that toxic contaminants such as heavy metals and dioxins tend to concentrate on very fine particulate (fly ash) which is captured by air pollution control equipment. This is the ash which is small enough to potentially become airborne. Therefore, it is reasonable to impose this additional requirement on waste combustor ash land disposal facilities. It should be noted that the potential for dust to become airborne at an ash land disposal facility is

generally less than the potential at a municipal solid waste land disposal facility because the moisture content of ash is consistently close to saturation, whereas municipal solid waste may be very dry.

Item L requires that leachate be sampled in accordance with subpart 16. Because leachate sampling is the operator's responsibility, even if he or she contracts with a laboratory to collect samples, it is reasonable to list this requirement in this part.

Item M requires that the leachate collection system be cleaned annually. In addition to the basis presented on page 528 of the Solid Waste SONAR for this requirement, which is identical to part 7035.2815, subpart 13, item K, (Appendix XXII), Agency staff believes frequent pipe cleaning is important at waste combustor ash monofills to prevent build-up of precipitated salts and metals within the pipes. If such build-up is allowed to progress to the point where the pipe is substantially clogged, it may be impossible to remove the blockage from the pipe. Even if the block only occurs near the top elevation of the pipe, depending on the clean-out system design, the block may prevent the owner or operator from having access to the rest of the pipe for cleaning.

Items N, O, P, Q, R and S are identical to the requirements of part 7035.2815, subpart 13, items L, M, P, R, S, and T, respectively. The bases for these requirements are presented on pages 529 to 533 of the Solid Waste SONAR.

Item T requires that at least three feet of ash or other approved material be placed over the liner by December 1 to protect it from freezing. It is necessary to protect the liner from freezing because when compacted clay freezes the water between the clay particles expands, increasing the distance between clay particles and hence the overall permeability (Appendix XX). Also, water which freezes within the leachate collection system may damage pipes or other leachate collection system equipment. As stated in the Solid Waste SONAR, "the liner system at a land disposal facility is the single most important item in controlling leachate movement from the fill area. Maintaining the integrity of the liner minimizes the risk associated with land disposal facility operations."

According to Appendix XX, as few as one freeze-thaw cycle can increase the permeability of clay by an order of magnitude. This increase is typically between one and two orders of magnitude for approximately 5 freeze-thaw cycles, with the degree of increase dependent on the type of clay and the clay moisture content. Even if the liner is constructed with a permeability of $1x10^{-9}$

centimeters per second, so that the permeability after freezing still complies with the rule requirement of $1x10^{-7}$ cm/sec, it does not make sense to spend time and effort constructing a liner with the lowest permeability possible for a given clay source and not take actions necessary to preserve the low permeability attained.

This requirement contains two key criteria: the required depth of the ash or other protective material, and the date of the year by which the protective material must cover the entire liner. Soils and other similar materials freeze from the surface down to a certain depth. This depth is dependent on the number of days during which the temperature is below freezing, and how cold the below-freezing temperature is on those days. The rate at which frost penetrates soil and other materials plays an important part in selecting the criteria of protective layer depth and date of placement. The clay barrier layer of the liner is protected from freezing by the sand drainage blanket and ash or other materials placed over the liner. The drainage blanket must be placed over the clay layer as soon as possible after the clay layer is finished, so it may be counted on to be in place before freezing weather begins, in addition to protecting the clay from drying and cracking.

The depth of ash required has been set at three feet based on the preliminary results of monitoring the temperature within the liner at the NSP Wilmarth type I ash storage facility. The liner was covered with approximately one foot of ash for the month of December and two feet after January 1. The temperature was monitored monthly throughout the winter. Results showed that the temperature of the liner did not go below 37 degrees Fahrenheit at any of the temperature monitoring locations (Exhibit VII.) Although based on this data one could state that two feet of ash appears to be adequate cover for freeze protection, Agency staff has set three feet as the minimum depth requirement to include a factor of safety to account for winters which are colder than experienced in this southern Minnesota location in 1990-1991. Also, the insulating property of other waste combustor ash may differs from that of the RDF ash placed over the liner at Wilmarth. For example, ash from a mass burn waste combustor may contain more large metal pieces which may act as conduits for cold to get closer to the liner. If a material other than ash is used as frost protection, it may be necessary to use a greater depth of the material to prevent frost from reaching the clay liner.

The date by which protection must be placed over the liner has been set at December 1. Agency staff believes that the rate at which frost penetrates the 12-inch drainage blanket will be slow enough to allow it to act as protection of the clay layer and piping system if the temperature drops below freezing before December 1. Although to be conservative it would be desirable to place a protective layer over the liner before any freezing days occur, the feasibility of this is limited by the short time period during the year when weather allows construction to occur, and the requirement of part 7035.2610 that new construction be certified before any waste is placed in the facility. Staff believes December 1 is a date which accomplishes the goals of this requirement without placing impossible limitations on the owner or operator.

Items U and V contain the same requirements as part 7035.2815, subpart 13, items V and W. The basis for these requirements is identical to that presented on page 534 of the Solid Waste SONAR (Appendix XXIII).

16. Subpart 16. Ground Water, Surface Water, and Leachate Sampling and Analysis.

This subpart requires that the owner or operator of a waste combustor ash land disposal facility monitor ground water, leachate, and, where required by permits, orders or stipulation agreements, surface water. The requirements regarding design, installation and maintenance of water monitoring systems are given in part 7035.2815, subpart 10, for MSW land disposal facilities. This subpart applies as well to waste combustor land disposal facilities. Therefore, it has been incorporated in its entirety.

The methods for collecting and analyzing samples, including the parameters for which samples must be analyzed, are specified by items A and B, in addition to part 7035.2815, subpart 14, items A, B and D to Q. Items A and B of this subpart replace item C of part 7035.2815, subpart 14. The basis for the items referred to in part 7035.2815, subpart 14 is presented on pages 534 to 539 and 557 to 575 of the Solid Waste SONAR. (Appendix XXIII).

> In pollutant sampling, a balance must be reached between a complete accounting of all possible pollutants and cost efficiency. . . . more chemicals might find their way into facilities than can be tested. A testing strategy must narrow and target the analyses. By targeting the analyses, sufficient data is gathered to determine in

a cost-efficient way if a land disposal facility is impacting water quality. For many years a common approach to this problem has been to test for a limited number of indicator substances that usually indicate a polluted condition. These tests are periodically supplemented with more complete analyses. Supplementary analyses characterize the chemical composition of water more completely and they include more substances that may threaten public health or the water resource.

Solid Waste SONAR, page 539.

Items A and B follow the approach discussed on page 539 of the Solid Waste SONAR. Three times per year, ground water must be analyzed for the routine parameters listed under item A, subitem (1). Once per year ground water samples must also be analyzed for the extended list of parameters given under item A, subitem (2). Similarly, leachate must be analyzed quarterly for the parameters listed in item B, subitem (1), and annually, for the parameters listed in item B, subitems (1) and (2).

The approach used to determine which parameters are included in items A and B, and on which list they are included (routine or extended), considered the likelihood that a given chemical would be found in waste combustor ash leachate, and the need to obtain baseline data on those chemicals. Most of the parameters listed are also required to be analyzed as part of the ash testing program required by proposed part 7035.2910. The parameters required by part 7035.2910 were selected based on results of past ash and ash monofill leachate testing which showed that the chemicals are present in ash and, at least in some cases, may be leached from ash. Parameters which are required by items A and B for analysis in ground water and leachate, in addition to parameters listed in part 7035.2910 are as follows:

Ammonia nitrogen was not typically found in leachate produced by laboratory leach tests. However, it has been found in actual leachate. Because ammonia nitrogen is produced by decaying organic matter under anaerobic conditions, it is evident that at least a small amount of microbial activity is occurring in ash monofills (Reference 7). Ammonia nitrogen is not found in laboratory leachate because microbial activity is not allowed to occur in the sample. It is useful to analyze leachate for ammonia nitrogen as a measurement of the amount of microbial activity occurring in the disposal facility. Also, significant levels of ammonia nitrogen may serve as a leachate indicator in ground water.

Total dissolved solids (TDS) are often used as a leachate indicator in ground water. Ground water which has been impacted by a land disposal facility routinely exceeds the secondary drinking water standard of 500 mg/l, as stated on page 545 of the Solid Waste SONAR. Knowledge of the TDS of leachate is necessary for a waste water treatment plant to be able to accept leachate. TDS are not tested as part of the ash testing program because they are not used as an indicator of ash toxicity. TDS analyses can also be used as a quality assurance check on the rest of the analysis results.

Nitrate + nitrite (reported as nitrogen) are oxidized forms of nitrogen. These substances are tested as a single unit because analytical procedures do not commonly distinguish between the two. Nitrate and nitrite have not been found in laboratory leach tests of waste combustor ash, and therefore are not required by part 7035.2910. This is not unexpected, because during combustion nitrogen is released as a gas as the organic material to which nitrogen is fixed is combusted. However, if anaerobic activity occurs under aerobic conditions in an ash land disposal facility, nitrate or nitrite may be produced. Because this scenario appears unlikely, nitrate and nitrite are required as part of quarterly leachate analysis but only annual ground water analysis.

Total suspended solids are measured as part of ground water and leachate analyses as a quality assurance check. They are not required by part 7035.2910 because the amount of solids contained in laboratory leachate is affected by a completely different set of factors than actual leachate. For example, ash itself and the drainage blanket can serve as a filter which removes solids from leachate as it travels through the fill. This is not simulated by the laboratory leach test.

Appearance, specific conductance, temperature and water elevation are also parameters which do not apply to ash laboratory testing. They are required by items A and B for the same reasons discussed on pages 548 to 549 of the Solid Waste SONAR.

The parameters required for analysis in ground water and leachate at waste combustor ash land disposal facilities are similar to the list of inorganic substances required to be tested annually at MSW land disposal facilities. Part 7035.2815, subpart 14, item C, requires that ground water at MSW land disposal facilities be tested three times per year for a long list of volatile organic chemicals. Volatile organic chemicals are a class of organic chemicals that are

common constituents of household and industrial solvents, degreasing agents, petroleum products, and other ubiquitous products. This subpart does not require analysis of ground water or leachate for volatile organic chemicals because they are very easily removed from waste and destroyed during combustion, as is the nature of volatile substances.

Item B of this subpart requires annual analysis of leachate for a number of polyaromatic hydrocarbons (PAH) listed in subitem (2). PAH which are present in waste entering the facility may be expected to be destroyed by the combustion process. However, because of their heavier molecular weight, the destruction efficiency of PAH is less than for lighter volatile organic chemicals, especially if the combustion process is less than perfect, e.g., some portions of the waste move through the combustor without being fully combusted. Also, some PAH may be formed as combustion gases cool. These substances are sorbed onto the surface of ash in the combustion chamber or fine particulate in the gas stream which is collected as fly ash by the air pollution control equipment. Such substances are known as "products of incomplete combustion". Data have shown that these substances are found at low levels in some ashes, however, they do not appear leachable, as expected based on the low solubility of these compounds (Appendix XI) Therefore, Agency staff believe that annual monitoring of leachate for PAH is adequate. If PAH are detected by annual monitoring, through the facility permit, the Commissioner may change their analysis frequency to quarterly in leachate and add them to the list of ground water monitoring parameters. The PAH listed in subitem (2) of item B are those which were detected in at least two facilities during the initial quarter of ash testing performed under the Temporary Program. Two additional substances, acetone and vinyl chloride, are also included because they have been detected in leachate (appendix III).

Dioxins and furans are also products of incomplete combustion. Dioxins are of concern because they are thought by some to be the most toxic substances known. However, dioxins and furans have negligible solubility in water, and have not been detected in laboratory test leachate or ash monofill leachate. Analyses of dioxins and furans are very expensive, costing approximately $1,000 per sample. In light of the cost of analysis and low probability that dioxins will be detected, this subpart requires annual analysis for the first two years and every other year thereafter, unless the Commissioner requires otherwise. As with PAH, if dioxins are detected, their monitoring frequency may by increased.

17. Subpart 17. Contingency Action.

This subpart is the same as part 7035.2815, subpart 15. The justification presented in the Solid Waste SONAR on pages 575 to 576 applies to this subpart also.

18. Subpart 18. Closure and Postclosure Care.

This subpart is the same as part 7035.2815, subpart 16. The justification presented in the Solid Waste SONAR on pages 576 to 581 applies to this subpart also.

E. Reasonableness of all-new part 7035.2910: WASTE COMBUSTOR ASH TESTING REQUIREMENTS

This part presents the testing requirements for mixed municipal solid waste combustor ash. The part prescribes the types of tests, frequency of testing, number of samples, and methods of sample collection and processing required. The Agency will use the results of ash testing for two main purposes. First, test results will demonstrate compliance with part 7035.2885, subpart 3, which requires that results of EPA Method 1312 leach test not exceed maximum leachable contaminant levels. Second, results will show whether the level of toxic contaminants in ash decreases over time.

Minn. Stat. § 115A.97 expresses the policy of the legislature that owners and operators plan and manage municipal solid waste combustors to reduce the quantity and toxicity of incinerator (waste combustor) ash. Draft rules for waste combustors reflect this legislative policy by requiring in proposed part 7001.1216 that permit applicants or owners and operators of municipal solid waste combustors describe in their permit application the activities that they intend to take to meet the goals of the above-referenced statute. The phrase "reduce the level of toxic contaminants" has been used in waste combustor rules rather than "reduce toxicity" because "toxicity" already has a specific meaning under hazardous waste rules part 7045.0131.

It is necessary to specify through rules the ash testing requirements which must be followed by owners and operators of waste combustors to obtain data needed to determine compliance with part 7035.2885 and the legislative policy.

1. Subpart 1. Definitions.

Subpart 1. Definitions. This subpart defines three terms which are used in this part. Because these terms are not used in other parts of chapter 7035, it is unnecessary to define them in part 7035.0300 along with other terms used throughout the chapter. Defining these terms allows the remainder of the part to flow more smoothly, rather than explaining these three terms each time they are used. The reasonableness of each definition is discussed below.

Item A: Analysis sample. Subparts 7 and 8 use the term analysis sample. Defining this term rather than repeating the phrase "which will be delivered to a laboratory for analysis" each time makes the rules easier to read.

Item B: Composite sample. A definition of this term is necessary because it is used frequently in part 7035.2910. This term was used in the Temporary Program, and should be familiar to persons who have performed ash testing under the Temporary Program. It is expected that many of these same people will continue to perform ash testing under the proposed rules.

Item C: Grab sample. This term, although frequently used by persons familiar with sampling, may not be familiar to other people. Therefore, this term is defined here to facilitate their understanding of the rules.

2. Subpart 2. Scope.

This subpart establishes the responsibility of all owners and operators of mixed municipal solid waste combustor facilities to comply with the requirements of this part. This also clarifies that ash testing is the responsibility of the waste generator, which in this case is the waste combustor owner and operator, and not the receiving waste disposal facility.

Some persons have stated that they believe ash which is not disposed of in Minnesota should not have to be tested. However, the requirement of Minn. Stat. § 115A.97 and draft waste combustor rules that waste combustors be planned and managed to reduce the level of toxic contaminants in ash and the quantity of ash

produced is not limited to waste combustors which dispose of ash in Minnesota. Therefore, ash from all waste combustors must be tested adequately to allow assessment of whether the toxic contaminant level reduction requirement is being met.

3. Subpart 3. Frequency.

This subpart, in conjunction with subpart 5, requires owners and operators to collect and analyze ash samples on a quarterly basis for a short list of parameters. Annual analysis of a composite sample formed from the quarterly samples for an extended list of parameters is also required.

Because the content of waste burned at a combustor varies over time, including significant variations based on the time of year, the characteristics of the ash produced also varies. Ash testing must occur frequently enough to account for these variations, without placing an unreasonable cost burden on the facility. Quarterly testing meets these criteria.

Ash sample collection must begin within seven calendar days before or after the fifteenth of January, April, July and October, unless otherwise approved by the Commissioner. Specific dates are identified in the rule so that sampling occurs at approximately the same time at all waste combustors, making comparison of data from different facilities more meaningful. Allowing sample collection to begin anytime during a fourteen-day period (seven days on either side of the fifteenth) gives the owner or operator the opportunity to select a time for sampling that is close to the date specified by this subpart yet convenient for the facility, considering such factors as staff workloads and scheduled downtime for repair work.

In some situations, a facility may desire to follow a different sampling schedule. For example, a local governmental agency may require monthly analysis of samples collected during the first week of each month. As long as the sampling procedures comply with the requirements of subpart 8, the Commissioner may approve analysis of quarterly samples collected on a schedule which differs from that dictated by this subpart. Because the need to have all facilities sample at the same time so that data is comparable between facilities is secondary to the need to ensure that data at each facility is comparable over time, deviations from the required schedule are acceptable when warranted by other concerns as long as a consistent sampling schedule is followed.

The total cost of the required testing has been estimated at between $12,000 and $24,000 per year. These figures include laboratory analysis costs and the cost of staff time for sample collection and processing. The first figure is based on reduced analysis rates for large numbers of samples. Under the Temporary Program a number of waste combustors coordinated a contract with one laboratory to get these reduced rates. The second figure applies to analysis of a small number of samples, e.g., samples from only one facility (Appendix XXII).

This subpart also requires that samples be analyzed within appropriate holding times, or 45 days, whichever is less. The appropriate holding time for mercury is currently 28 days. The holding time for other metals is 180 days. It is necessary to limit the length of time which samples are held because bacterial growth and other factors over time may change the chemical composition of a sample.

4. Subpart 4. Test Methods.

This subpart lists test methods to be used, the parameters to be tested for and the detection limits which must be achieved. This subpart requires that laboratory analysis methods be EPA or American Society of Testing and Materials (ASTM) methods. Because both EPA and ASTM have programs for developing and issuing specifications for laboratory testing, it is reasonable to make use of these established programs. This is common practice by the Agency and other regulatory entities which required testing to determine compliance. Items A and B relate to chemical testing, while item C covers physical tests. Items A and B are further broken down into two lists: one is the short list of parameters for which quarterly testing is required, the other is the extended list of parameters for the annual composite sample analysis.

Specific laboratory methods have not been required in the rules because all laboratories do not have the equipment necessary to perform a given method, yet they may be able to perform analyses using other equipment and methods which achieve adequate accuracy and precision. Also, methods can be updated as laboratory technology changes. As more data is collected, it may become apparent that a method which achieves a greater or lesser detection limit is warranted.

The laboratory method required for dissolution of ash as part of total composition analysis is identified under subitem (3). The method to be used for

testing dioxins and furans is also specified. These methods are the same as those used under the Temporary Program. Whereas there are a number of methods which may provide equivalent results for analysis of the total content of a parameter contained in a liquid (such as IC or DC plasma, atomic adsorption, and graphite furnace), the different methods which exist for dissolution of a solid may greatly affect analysis results. This is discussed in more detail below. Using the same methods for total composition analyses will allow meaningful comparison of future data to data already collected.

a) Item A. Total Composition.

Total composition analysis identifies the amount of a given parameter which is present in ash in a form which may be considered soluble over geologic time. That is, the test method specified (EPA SW-846 3050) does not quantify 100 percent of the parameter which is present in the ash. During the test strong acids are used, sometimes along with heat and/or pressure to break down into solution the solid being tested. Silicate compounds contain bonds which are very difficult to dissolve. These bonds are not completely broken down when the required test method is used. Test methods exist which are capable of breaking down the silicate bonds to get a more complete dissolution of the solid. However, the needs of the ash testing program can be fulfilled by using the required method. It would be unreasonable to require that the other more aggressive methods be used since they are more costly, may not yet be EPA-approved, and would not be comparable to ash data already collected.

b) Item B. Leaching Potential.

The leach test required is EPA Method 1312, the Synthetic Precipitation Leach Test for Soils (also known as the Synthetic Acid Rain leach test). This test was selected because MPCA staff believes it is the EPA-accepted test which most closely simulates in-field leaching conditions of a land disposal facility limited to waste combustor ash. It is also the test which was required under the Temporary Program. Continued use of this test will produce data which can be compared to data already collected.

A similar test, EPA Method 1311, the Toxicity Characteristic Leachate Procedure (TCLP), is the test currently used to determine whether a waste should

be classified as hazardous or nonhazardous based on toxicity characteristic. This test requires the addition of acetic acid to reagent water to form the extraction solution. The acetic acid is added to simulate the organic acids of decomposition which industrial wastes co-disposed with putrescible refuse would be exposed to in a municipal solid waste land disposal facility. Ash disposed of in a monofill as required by part 7035.2885 is not exposed to such acids. Therefore, EPA Method 1312 simulates the conditions of an ash-only land disposal facility more accurately than EPA Method 1311.

A group of experts in the area of municipal solid waste combustion concluded that "the EP toxicity test and TCLP leaching tests are not adequate for evaluating utilization and disposal options for ash residue from municipal solid waste incineration. For example, concentrations of lead in leachate taken from ash residue monofill disposal sites are typically far lower than those indicated by the EP toxicity or TCLP test results." (Reference 4). Results of the Method 1312 leach test more closely approximate actual leachate values (Appendix XIV).

Total composition and leach test data will be used to determine whether the level of toxic contaminants in ash decreases over time. Both types of test data are useful because not all sources of contaminants such as lead and cadmium in the waste stream contribute equally to the leachable contaminants in ash. For example, lead from pigments and plastics may be more leachable in ash than lead from a battery or lead pipe. Leachable toxic contaminants are of environmental concern from a water quality perspective, while total toxic contaminant levels are of concern from an air quality point of view. Therefore, by considering both total and leachable contaminant levels, the effect on ash of changes in wastes burned or operations of a waste combustor can be evaluated.

c) Parameter Selection.

The parameters required for quarterly total composition and leach test analysis (Table 1, the "short list") were selected based on a number of factors. First, the parameters selected have been detected in actual leachate or using the Method 1312 leach test at levels greater than typical ambient ground water concentrations (Appendix XIV). Second, MPCA Water Quality Division staff has identified some of the selected parameters as present at levels of potential

concern for surface waters. Finally, whether a parameter has a primary drinking water standard determined if it was placed on the quarterly testing or annual testing list. Parameters such as chlorides, sulfates and sodium, which have secondary drinking water standards (secondary standards are based on aesthetics rather than health effects) but not primary standards, were not included on the quarterly list, even though they are known to be present in waste combustor ash at high levels.

With a few exceptions the parameters required by this subpart are the same as those required by the Temporary Program for Method 1312 analysis. Beryllium, cyanide, nitrate/nitrite as N and thallium are not required because these parameters were rarely or never detected in analyses done under the Temporary Program. Total suspended solids, total dissolved solids, biological oxygen demand, and ammonia N were dropped because they're not toxic and therefore not good indicators of the level of toxic contaminants of concern in ash. Also, the amount of suspended and dissolved solids which may be expected in ash leachate is probably not well predicted by the laboratory leach test, since there are many factors which affect the quantity of these found in actual leachate. Also, part 7035.2885, subpart 5, does not set maximum leachable contaminant levels for these parameters. Calcium, magnesium and sodium have been retained on the list, although they're not considered toxic, because they're constituents of some additives used as part of waste combustor operation which may affect the leaching potential of other constituents. Alkalinity is also required to assess the effect of operational or design changes on ash characteristics.

Arsenic and selenium, although not often detected using laboratory leach testing, are included on the required lists because they have been detected in actual leachate at levels between one and ten times ambient drinking water levels (Appendix XIV).

The organic parameters required by the Temporary Program, consisting of 13 PAH, are not required by this subpart. They were rarely detected by total composition analysis, and almost never found in Method 1312 leachate. Therefore, they do not serve as good indicators of changes in the level of contaminants in ash. Because the level of PAH found in ash should decrease with improved combustion efficiency, monitoring the percentage of combustibles remaining in ash, as required by item C, will provide the Agency with a gage of the potential for ash to contain organics such as PAH. It should also be noted

that part 7035.2885, subpart 16, item B requires annual analysis of actual ash monofill leachate for PAH. Because PAH are not expected in ash leachate at significant levels, it is reasonable to concentrate on occasional testing of leachate, where the presence of PAH would be of most concern, rather than requiring PAH as ash laboratory testing parameters.

Analysis of the total composition of dioxins and furans in ash is required annually. Under the Temporary program quarterly dioxin analysis was performed to obtain a data base for use in developing rules. Although a number of interested parties have requested continued quarterly dioxin analysis, Agency staff believes that quarterly analysis is unnecessary because 1) a maximum leachable contaminant level has not been established for dioxin; 2) testing has shown that ash from most facilities contains only very low levels of dioxins (i.e., less than one part per billion) and 3) the cost of dioxin analysis, approximately $1,000/sample, makes use of this parameter as a main indicator of changes in the level of contaminants contained in ash infeasable. As noted in the preceding paragraph, monitoring ash percent combustible may be used as an indication of combustion efficiency. Also, subunit (j) of item A allows the Commissioner to require that a facility perform quarterly analysis of dioxins and furans based on results of previous testing.

Item A, subunit (j), and item B, subunit (l) give the commissioner authority to move parameters from annual list to the quarterly list on a facility-specific basis. This clause allowed staff to place parameters which were only detected at one or two facilities on the quarterly lists. Continued quarterly analysis of those parameters at the facilities where they have been more frequently detected will be required. The Commissioner will decide which additional parameters a facility must analyze samples for based on the results of previous ash testing and knowledge of the waste burned.

d) Detection limits.

Subpart 4 lists detection limits which must be met for each parameter tested. Agency staff selected the detection limits by considering the detection limits achieved during previous sampling, and the need to obtain data which may be used to assess changes in waste combustor ash toxicity over time and to determine compliance with the maximum leachable contaminant levels.

Specifically, for EPA Method 1312 analyses detection limits were calculated for most parameters by dividing the maximum leachable contaminant levels by 15. One-fifteenth the maximum leachable contaminant levels is equal to the RALs for many parameters, thus, detection limits often equal the RALs. This is useful for the purposes of assessing ash toxicity because a waste which leaches below the RALs is generally considered to be of minimal concern. Arsenic has been divided by 30 because it the most recent RAL (January, 1991) for arsenic has been greatly decreased from the RAL used as the basis for the maximum leachable contaminant levels (see discussion regarding part 7035.2885, subpart 5).

Manganese, nickel, zinc, barium, boron, copper and tin detection limits are equal to the highest detection limits reported for testing performed under the Temporary Program. This was done because the maximum leachable contaminant levels divided by 25 for those parameters were much greater than the former detection limits. If the detection limits are set too high, data collected in the future may not be useful for assessing whether the level of contaminants in ash decreases with time.

For parameters for which maximum leachable contaminant levels have not been established, detection limits have been based on detection limits previously reported and in some cases surface water criteria. For example for aluminum the chronic surface water standard is 125 micrograms per liter (ug/l). Previous analyses using EPA SW-846 Method 6010 achieved a detection limit of 25 ug/l. Analyses performed using a different method at another laboratory achieved a detection limit of 1000 ug/l. Review of ash testing data for combined ash using EPA Method 1312 shows that aluminum was detected at 11,500 ug/l or more at all facilities except Hennepin, where it was detected at an average less than 25 ug/l. With the exception of Hennepin County, therefore, it is not necessary to use a method with a low detection limit, because results may be expected to be greater than the detection limit. Aluminum is a parameter which staff intend to track to follow the effect of aluminum recycling on waste combustor ash. Agency staff concluded based on the information presented above that 1000 ug/l is a satisfactory maximum detection limit for method 1312. The aluminum detection limits for total composition was then established by dividing 1000 by 50 instead of 25 as used for other parameters (as discussed below) to ensure that if the pH of ash greatly reduces the leaching potential of aluminum, so that it is not detected by Method 1312 (as Agency staff believe is the case with

Hennepin County), total composition testing may still be used to assess the reduction in ash aluminum content.

Detection limits for alkalinity, calcium, chloride, sulfates and sodium were set by selecting a level well below the lowest level detected but yet above the method detection limits achievable using standard laboratory equipment.

For iron the maximum detection limit was set at 10 ug/l for Method 1312 because test result for facilities which used laboratories with detection limits of 10 or lower detected iron between 7 and 37 ug/l. The laboratory which reported iron as nondetectable used a detection limit of 100 ug/l. Staff believe this data show it is necessary and reasonable to use 10 as a detection limit for iron to obtain useful data.

Total composition levels were set by dividing EPA Method 1312 detection limits be 25. This is based on the following: If 100 grams (g) of sample are leached using a leach test such as EPA Method 1312 which uses a liquid to solid ratio of 20:1, 20 x 100g of liquid are mixed with the waste. 2,000 g of water is equal to 2 liters of water. If a parameter, for example lead, is present in the waste at Y mg/kg according to total composition analysis, and 100 percent of the lead goes into solution during the leach test, then the concentration of lead in the test leachate (Z) should be:

Z ug/l = (Y mg/kg)(100 g ash/ 2 liters water)(1 kg/g)(1000 ug/g) = Y x 50 ug/l.

Conversely, if the concentration in leachate is Z ug/l, then the total composition concentration in mg/kg may be expected to be Z divided by 50, again assuming 100 percent solubility. Therefore, the total composition detection limits corresponding to 100 percent solubility would be 1/50 times the EPA Method 1312 detection limits. That is, to ensure that a parameter which is detected using total composition analysis is detected by Method 1312, this relationship would have to hold true between the two detection limits. However, typically much less than 100 percent of each parameter is soluble in the Method 1312 extraction fluid. Therefore, the Method 1312 detection limits in ug/l must be less than 50 times the total composition detection limits in mg/kg. Setting the relationship between total composition and Method 1312 detection limits so that total composition limits (in mg/kg) equal 1/25 the Method 1312 limits (in ug/l) corresponds to 50 percent solubility.

e) Item C. Physical Characteristics.

Item C requires analysis of ash for moisture content and percent combustible. Both of these tests are relatively inexpensive. Performance of these tests produces useful information without significantly increasing the cost of the ash testing program.

Analysis of the percent of ash which is combustible is used to determine whether complete combustion is being achieved. Complete combustion is needed to destroy the organic content of the waste. If a significant amount of organics remain in the ash, the organics may decompose and release organic acids, which can increase the leaching potential of metals such as lead and cadmium which are present in ash.

Moisture content analysis of ash samples is needed because moisture content affects chemical test results. For this reason, subpart 10, item A, requires that results be reported on a dry weight basis, to prevent variations in ash moisture content from causing changes in test results. Water may "dilute" the contaminants present in ash, since results are given as the ratio of the weight of a given contaminant to the weight of ash, e.g., 200 milligrams (of the contaminant) per kilogram (of ash).

f) Alternative test methods.

Item D allows the owner or operator to propose alternative test methods for the Commissioners review and approval. That is, test methods which other than those specified for metals digestion (EPA Method 3050), dioxin and furan analysis (EPA Method 8290), moisture content (ASTM D3173) and percent combustible (ASTM D3174), or test methods which are not EPA- or ASTM-approved as required by the first paragraph of this subpart. It is reasonable to leave open the opportunity for use of other test methods which the commissioner determines are appropriate, because test methods are subject to frequent change and development. In some cases the best test to use to achieve the goals of the rules may not yet be approved by EPA or ASTM.

5. Subpart 5. Number of Analyses Required.

This subpart lists the number of replicate samples which must be analyzed

using each type of test. Item A identifies the requirements for waste combustors which manage fly ash and bottom ash separately; Item B identifies the requirements for waste combustors which manage fly ash and bottom ash together as combined ash. Each item is further subdivided into quarterly and annual requirements.

Selecting the number of replicate samples which must be analyzed requires balancing analysis costs against the need to get reliable data. Statistical guidelines generally consider 30 the minimum number of samples needed in a data set to apply the central limit theorem and related statistical comparisons unless the population being sampled is known to be symmetric (Reference 8). The cost of analyzing 30 samples each quarter using each type of test would be roughly $110,000 per year, which is unreasonably costly.

The number of replicate samples required depends on whether fly ash and bottom ash are managed separately or as combined ash. For facilities which manage fly ash and bottom ash separately, the type of test also affects the number of replicate samples required.

a) Item A.

For facilities which manage fly ash and bottom ash separately, a minimum of four replicate samples of bottom ash and two replicate samples of fly ash must be analyzed to fulfill the total composition testing requirements. More samples of bottom ash than fly ash are required because experience has shown that variation among fly ash replicate samples is less than variation among bottom ash samples. This can be attributed to the differences in particle sizes which make up the different types of ash. Fly ash can be mixed much more thoroughly than bottom ash because fly ash consists of very small particles. When a fly ash grab sample contains an unusually high concentration of toxic contaminants, the contaminants will be dispersed evenly throughout the composite sample formed from mixing grab samples, and the contaminants have a fairly equal chance of being contained in the 10 or so grams which are analyzed. On the other hand, bottom ash may contain relatively large particles (even though it must pass a 3/8" screen). Some of these larger pieces of ash, such as a button battery, may contain a high amount of certain toxic contaminants. Because the contaminants are contained within a single piece of ash, rather than being spread throughout

the composite sample, chance determines whether the concentrated contaminant, i.e., the battery will be included in the subsample sent to a laboratory for analysis.

This greater variability among bottom ash total composition replicate samples is evident in the data collected through the Temporary Program (Appendix XIII and Exhibit VI). A similar evaluation of Method 1312 data shows that fly ash and bottom ash leach test results have fairly similar ranges of variability (Exhibit VI and Appendix XIV). For this reason an equal number of replicate samples, three, is required for bottom and fly ash samples analyzed using the Method 1312 leach test.

Two replicate samples, although not statistically significant by themselves, are preferable over one sample because if the two sample analysis results are fairly similar, one can assume that the actual average of the ash tested is near the results received. Two very dissimilar results alert the person reviewing the data that the actual average of the ash tested cannot be determined from the two test results.

In reviewing ash testing data to satisfy the goals identified above, the Agency anticipates that a summary of data gathered over two or more years will be considered in aggregate (likely as part of the semiannual Solid Waste Policy Report to the Legislature). Therefore a minimum of sixteen data points (two per quarter for eight quarters) will be available to consider for each parameter on the quarterly list, which approaches the number needed to make statistically valid comparisons.

A minimum of two analyses per year are required for parameters on the annual list, including dioxins and furans. Some people have requested that dioxin and furan analyses be required quarterly, because these compounds are considered to be very toxic. Owners and operators of waste combustors prefer less frequent testing because the cost of dioxin and furan analyses is considerably more expensive than other analyses. Therefore, the need for quarterly dioxin and furan testing has been carefully evaluated. MPCA staff has concluded that for most facilities, annual ash analysis for dioxins and furans is adequate. Subpart 4 allows the director to require quarterly dioxin and furan testing by owners or operators of waste combustors whose ash contains unusually high levels of dioxins and furans (based on quarterly test results collected during the first year of ash testing), or combustors who change design or operation.

Frequent dioxin and furan testing would not be useful as one of the main indicators of whether the level of toxic contaminants contained in ash decreases over time. Dioxins and furans, if present in ash, are most likely formed during the combustion process rather than being contributed by the waste. Therefore, future activities relating to alteration of the waste being burned would not have a direct impact on dioxin and furan content of the ash. One component of the waste stream, chlorine, is related to dioxin and furan production. However, since chlorine is present throughout the waste stream, modification of the waste stream may not significantly alter dioxin and furan content of ash.

b) Item B.

Six replicate analyses of quarterly testing parameters are required for facilities which manage combined ash, with the exception of dioxins and furans. Based on review of data collected through the Temporary Program, six samples for most parameters appears to be an adequate number to allow statistically significant comparison of data collected during different quarters. The number of data points available for consideration as part of the semiannual summary for parameters on the short list will be 48.

In determining the number of replicate samples required the Agency also sought to ensure that facilities which elect to manage fly and bottom ash separately are not financially penalized for doing so (Appendix II). The cost of ash testing for a facility which separately manages its ash streams is nearly the same as the cost for facilities managing combined ash.

Physical testing is not required as part of the annual testing program because there is only one set of tests specified for physical testing, rather than a short list and extended list as required for chemical testing. Requiring that the annual composite sample be subjected to physical testing would unnecessarily repeat information already gathered during quarterly testing.

Subitem (2) of items A and B requires that annual composite samples be formed from equal portions of quarterly samples so that the annual sample will represent the average quality of ash produced over a year. This process clearly makes it unacceptable to attempt to influence the results of annual analyses by including more ash from quarters which are expected or known to contain lower levels of toxic contaminants than other quarters.

6. Subpart 6. Ash Sampling Plan.

Each waste combustor must sample ash in accordance with a plan which has been reviewed and approved by the Agency to ensure that sampling methods comply with the requirements of this part, and to promote consistency between facilities. The twelve currently operating waste combustors already have approved sampling plans, so this requirement does not require an expenditure of time or money for existing facilities. It notifies owners and operators that they must follow their approved plan, and any changes in sampling equipment or methods must be approved by the Director before they are used. Because the methods used to collect ash samples may significantly affect ash test results, it is reasonable to require that ash sampling follow a plan which is scrutinized by the Agency.

Items A to B list information which must be included in the plan. This assists the owner or operator in preparing an acceptable plan, and makes it clear to both the owner and operator and Agency staff reviewing the plan what the criteria are which should be considered as part of review and approval of the plan. In general, the goal of the plan should be to collect ash samples which are representative of the average quality of ash produced at the facility over a one-year time period. The plan should be written in a clear manner. The plan must be used by persons who collect ash samples. Once the plan has been approved, sample collection should follow the plan precisely, unless Agency staff approve a deviation from the plan. If an event out of the ordinary occurs at the waste combustor during the sample collection period, ash sampling should continue if the waste combustor continues to operate, unless Agency staff approve postponing sample collection. Only if the event is something which does not usually occur at least once per year, Agency staff should approve postponing sample collection.

7. Subpart 7. Sampling Equipment Requirements.

Requires that equipment used for sample collection, mixing and storage meet standards designed to prevent contamination of ash samples, that is, to ensure that the results of sample analyses are not influenced by the equipment that ash comes into contact with during sample handling.

a) Item A.

Item A requires that equipment be constructed of materials which are compatible with ash. Compatible materials are those which will not react chemically with the ash in such a way that molecules of the equipment are transferred to the ash sample. Examples of materials which are considered compatible with the ash include stainless steel, glass, teflon and most rigid plastics.

Consideration was given to using the term "should" rather than "must" in this situation because it is in the best interest of the waste combustion facility owner or operator to use equipment which does not contaminate the sample. Using contaminating equipment can make results worse than they would be if noncontaminating equipment were used. However, if the "contaminants" added to the ash are elements which are not considered toxic, this "contamination" can actually dilute the toxic contaminants which are in the ash and improve the test results. Therefore "must" has been used rather than should.

Under the Temporary Program most facilities used garbage cans made of either galvanized steel or "rubbermaid" rigid plastic. Galvanized steel contains zinc and possibly some other metals. MPCA staff observed that after use, steel cans showed rust and pitting, evidence of reaction between the steel and the moisture, alkaline (and therefore corrosive) ash. However, it is likely that the effect on the ash samples was minimal because ash has a high content of zinc to start with, so addition of a small amount of zinc would not greatly affect sample analysis results. Also, only ash which touches the can would be affected. The volume of affected ash compared to the total volume of ash in the steel container is small. Ash stored in these large containers is mixed prior to collecting a small subsample for analysis, so that, again, the overall effect on sample test results is likely small.

The above discussion justifies requiring that the containers used to hold analysis samples be constructed of clearly noncontaminating materials. Also, equipment such as scoops which are used to collect grab samples should be selected very carefully, since a fairly large portion of the ash collected comes in contact with this equipment, although only for a short time period. On the other hand, some leeway should be allowed for the large containers which are used for holding grab samples prior to mixing.

b) Item B.

This item requires that containers used to hold analysis samples be prepared in accordance with standard laboratory procedures as identified in two specified documents. According to the MPCA staff person responsible for reviewing quality control and quality assurance manuals for various environmental monitoring programs, the two documents referred to in this item set out container preparation specifications which the MPCA considers to be minimum requirements. These documents are readily available, and are familiar to laboratory personnel who are likely to be hired by waste combustor owners and operators to perform sample analysis. This requirement makes clear that unless the owner or operator is familiar with and capable of performing the specified container preparation steps, which include instructions regarding chemical rinses, they must contract with a laboratory to supply properly prepared containers, as is common practice.

This item does not require that containers used to store grab samples be prepared as required by the referenced documents. The large volume of grab samples which must be stored to comply with the requirements of subpart 8 dictates that a number of very large containers be used for storage. Although these containers should be scrubbed and rinsed as much as possible, using acid rinses on these containers, as required by the procedures of the referenced documents, would be prohibitively difficult, and unnecessarily produce waste acids which are a hazardous waste. Only a small fraction of ash which becomes part of an analysis sample will have been in contact with these large containers used for holding grab samples, whereas a significant amount of the analysis sample actually contacts the analysis sample container. Therefore, it is reasonable to require thorough procedures be followed when preparing containers for analysis samples.

c) Item C.

Cleaning sample collection equipment as required by item C is accepted sampling practice. Cleaning between uses for collection of grab samples of the same type of ash which will eventually be mixed together is not necessary. For this reason covering the equipment to protect it from outside contamination

(e.g., contamination from fly ash dust in the air) rather than cleaning it between every use is allowed.

d) Item D.

Item D requires that the size of the opening of equipment used for ash sampling be large enough to collect a reasonably complete range of particle sizes. This is necessary to collect a sample which is representative of all ash produced. If a 3" diameter jar was used to collect ash samples at a facility where 30 percent of the ash produced is greater than 3", the results of sample analysis could be significantly different than the average quality of the entire ash stream produced. Different size ash particles contain different amounts and types of toxic contaminants. For example, larger pieces of ash typically consist of metal objects, which would include a lot of iron, and large pieces of slag (resolidified glass and metal which melted at some point during combustion) which would likely include a lot of silica, the main component of glass. The very fine ash contained in combined ash is mostly fly ash, which has been shown to contain much higher levels of toxic metals such as lead and cadmium (Appendix XIV).

It would be unreasonable to require that collection equipment be able to collect <u>all</u> sizes of ash, since some facilities, especially mass burn waste combustors, have been known to have very large items such as bike frames, mattress springs, and even hot water heaters come out with the ash. Twelve inches has been set as a minimum diameter for these facilities because it is estimated that over 95 percent of ash produced is less than this size, so that sample results are not unduly affected by eliminating very large pieces of ash.

For RDF or other facilities which do not produce ash containing large items, a minimum opening size of 3 times the diameter of the largest ash particle is required. Selection of "3 times" is based on ASTM method D2234-89 "Standard Test Methods for Collection of a Gross Sample of Coal" (Reference 31).

8. Subpart 8. Sample Collection Methods.

The methods used to collect ash samples can greatly affect the results of ash sample analysis. For data to be recognized as a reliable representation of

the characteristics of ash produced at a given facility, standard sampling methods must be followed. This subpart states some general requirements for sampling, in addition to listing minimum specific requirements for sample collection.

In this subpart Agency staff have attempted to present guidance which is specific enough to be useful, while still allowing room for differences in sampling methods between different facilities. A sampling method which works well at one facility may be inappropriate or even impossible to use at another facility. This approach also allows updating sampling methods to meet future changes in acceptable methodology. Therefore, it is reasonable to establish standards in this subpart which, for the most part, are performance standards.

Item A requires that samples be representative of the average quality of ash produced at the waste combustor during the sampling event. This is one of the main goals of any sampling program. The design and operation of waste combustors are complex enough to cause unrepresentative samples to be collected if careful consideration is not given to where and when samples are collected. For example, one of the most common ash sampling errors is made in collecting samples of combined bottom and fly ash. Pollution control equipment used on waste combustors, such as electrostatic precipitators and bag houses, intermittently releases fly ash which has been collected. A conveying system operates periodically to add fly ash to bottom ash. Combined ash sample collection must be timed to make sure that a proportional number of samples is collected during fly ash addition to create a final sample which is representative of the overall average ash quality. Collection of samples from a pile or other situation where segregation of ash particles based on size or weight occurs is another situation where care must be taken in selecting a sample collection method to avoid collecting an inordinate amount of fine or coarse ash.

Item B requires that samples be collected at times and locations which have been selected by the owner or operator before the quarterly sampling period begins. The goal of this requirement is to decrease the influence of human judgment on the samples which are collected. For example, if the sampling plan for the quarter says to collect a sample at 4:15 p.m. on Tuesday, a sample should be collected at 4:15 regardless. If the person collecting samples does not follow a predetermined schedule, they may decide when to collect samples

based on whether the facility is operating well, or the type of waste being burned. The goal of sampling is to collect samples which represent the average quality of ash, not just the quality of ash produced when the combustor is operating at optimal conditions. Collecting grab samples on a predetermined schedule will help achieve this goal.

Item C requires that persons qualified by training and experience collect ash samples. The facility ash sampling plan required by subpart 6 identifies specifically what training must be received. Such training must at a minimum include on-site instruction in sample collection and processing by someone who is familiar with the ash sampling plan, and, if possible, has previously collected samples at the site. Training for waste combustor operators, including ash sampling, is also available through a program coordinated by the Minnesota Resource Recovery Association and the Rochester Technical Vocational Institute. This requirement will help achieve the goal of collecting representative ash samples. Because owners and operators are required by subpart 6 to collect samples in accordance with an approved ash sampling plan, it is in their best interest to train staff who collect samples so that they are familiar with the sampling plan. Therefore, this requirement is not a burden for owners and operators to comply with.

Item D requires that owners and operators protect samples from changes in composition due to exposure to precipitation, wind, sun, absorbent, or reactive materials, and extremes of temperature. This ensures that the results of sample analysis reflect the actual quality of the ash produced. Exposure to precipitation can alter the moisture content of the samples, and possibly the chemical composition if water causes chemical reactions to occur or leaches contaminants out of the sample as it passes through. Wind exposure can remove fine particles from the sample as airborne dust. Exposure to open air can also add contaminants to the sample by allowing dust to settle onto the sample. Absorbent and reactive materials may add or remove contaminants from the sample. High temperatures can cause certain parameters to volatilize, while freezing a sample can cause physical changes. Storing samples in covered containers constructed of nonreactive, nonabsorbent materials complies with this requirement.

Item E requires that circulation of air through the sampling equipment be minimized to prevent the loss of fines and moisture. In addition to covering

sample storage equipment, this requires that mixing equipment be covered. This is especially important when mixing samples of fly ash, which typically consists of very dry, fine particles which easily become airborne.

Item F requires that the owner or operator take analysis samples (samples sent to the laboratory for analysis) from composite samples formed by combining a number of grab samples. Subitem 1 requires that grab samples be collected each day of the week for at least one week. It is important that samples be collected on each day of the week because garbage hauling services, who deliver waste to combustion facilities, typically pick up waste from different locations each day of the week. Subitem 2 requires that grab samples be collected at least eight times per day at intervals of one hour or more. Compliance with this requirement ensures that samples represent the different wastes burned and changing operating conditions which may occur during the day. MPCA staff considered requiring sample collection every hour for twenty-four hours. However, this becomes a significant burden on facility staff time, especially for small waste combustors. Also, collecting more samples each day results in a larger quantity of ash which must be stored, processed and mixed. Therefore, sampling over at least an eight-hour period is required, as was done under the Temporary Program. Subitem 3 requires that samples must comply with minimum weight standards and must be of approximately equal volume. The minimum weight requirements for finer ash such as fly ash are less than those for ash which contains larger material, such as bottom ash or combined ash. This is based on standard material sampling principles that dictate that more sample must be collected for coarse materials than fine materials to achieve the same degree of accuracy in predicting the characteristics of the population being sampled.

Item G requires that the owner or operator retain duplicates of samples submitted to the laboratory for analysis for at least one year. As part of a ash quality monitoring program the Agency collects split samples each year from a number of selected waste combustors. These samples are then analyzed by a laboratory selected and paid by the Agency. Laboratories and facilities don't know ahead of time when split sampling will occur at their facility. The purpose of this is to check the quality of results reported by the facilities, to help deter data manipulation, and to encourage laboratories to follow good procedures at all times. It is also good sampling practice to keep duplicate samples on hand in case results are unexpectedly different than previous

results, so that duplicate samples may be analyzed if necessary to determine if the change is due to laboratory error.

The minimum amount of ash to be retained for each composite sample, three pounds, is approximately equal to 1500 grams. The amount of ash used for performing laboratory leach tests such as Method 1312 is 100 grams. Thus enough ash would be available to perform 15 leach tests. The maximum number of samples the Agency is typically able to collect for split-sample analysis is three. If the Agency laboratory budget allowed analysis of a greater number, it is likely that six samples (the same number as the facility is required to analyze each quarter) would be collected from the retained ash. If the results of the Agency analysis differ significantly from the facilities, enough ash would still be available for use to determine which laboratory is in error. Three pounds of ash, at a density of 1500 pounds per cubic yard, would occupy the space of approximately one half gallon. Considering that these samples must be kept refrigerated, as required by item I of this subpart, it would be unreasonable to require that a significantly greater volume of ash be retained.

Calculation: $(3\ lb)(1\ yd^3/1500\ lb)(27\ ft^3/yd^3)(8.34\ gal/ft^3) = 0.45$ gallon

Item H requires refrigeration of analysis samples and the samples held in accordance with subpart 8, item G. Refrigeration of all grab samples is not required because 1) the volume of ash would be prohibitive, and 2) grab samples are only held for a short period of time, generally one week or less. Standard sampling methods often dictate that samples be stored at 4 degrees celcius. Method 1312 (part 6.4) requires sample refrigeration. Refrigeration inhibits growth of bacteria which may alter the chemical composition of the sample. It is reasonable to take precautionary measures to ensure the accuracy of ash testing data.

9. Subpart 9. Sample Processing.

This subpart presents the steps which must be followed to reduce the particle size of ash samples as required by most laboratory leaching procedures, including EPA Method 1312. This subpart also requires thorough mixing of grab samples to form composite samples. Because fly ash inherently consists only of

fine particles, only the mixing steps of items A and H apply to fly ash. Bottom and combined ash must be processed according to items A to H.

Item A requires that grab samples be mixed together to form composite samples for each type of ash. If a facility only samples combined ash, only a combined ash composite must be formed. If a facility separately collects samples of fly and bottom ash, one composite of each type of ash must be formed.

Item B requires that samples be screened using a 3/8" screen. 3/8" (9.5 mm) is the screen size specified by Method 1312, part 7.1.1. Although each grab sample may be screened at the time it is collected, the owner or operator may elect to pool grab samples together and then screen a larger volume of ash at one time. The latter method has been typically followed under the Temporary Program. This subpart does not prohibit the former method, however, since it is not required that step B necessarily follow step A.

Under the Temporary Program some owners or operators only screened a portion of the ash collected. No minimum amount of ash which must be screened, however, was set. This part specifies 35 pounds as the minimum amount of ash to be screened. At a density of 1500 pounds per cubic yard, this is the weight of approximately five gallons of ash. If all ash is processed, including particle size reduction, and then mixed, a greater chance exists of the final analysis sample including equal portions of each grab sample collected. However, because screening and size reduction are very time-consuming tasks, it is not required that all ash be screened. It is in the waste combustor owner or operator's best interest to screen as much ash as possible, as this should reduce sample variability between quarters, and increase the accuracy of the data. Therefore a minimum level has been set which keeps the burden of this requirement reasonable, while leaving the owner or operator the final decision regarding the amount of ash screened.

Item C requires that the weight of ash which passes through the screen and the weight of ash which does not be recorded to determine what percent of collected ash is greater than 3/8" before particle size reduction. The amount of ash which was originally greater than 3/8" will be compared to the amount of ash which is still greater than 3/8" after particle size reduction. If a facility has an unusually small difference between the two numbers, MPCA staff may want to review the facility's size-reduction process to see if it is adequate. Also, differences between quarters in the percent of oversize ash

which is reduced to less than 3/8" may be relevant when comparing data over time to see if the levels of toxic contaminants in ash is reduced.

Item D requires that at a minimum friable pieces of ash be reduced in size. Friable means "readily crumbled; brittle" (The American Heritage Dictionary, 2nd Edition). The rules don't require that all oversize ash be reduced in size because: 1) it is nearly impossible to reduce the size of some things found in ash, like heavy bolts, and 2) data collected under the Temporary Program indicates there is not a discernible difference in Method 1312 leach test results between oversize ash and undersize ash.

Experience processing ash samples gained under the Temporary Program has shown that ash which does not pass through the screen includes slag, which is usually brittle and may be reduced in size by striking the ash with a large hammer. This is often done on top of the screen, which seems to work well as long as a heavy duty screen is used. Oversize ash also typically includes wire and pieces of metal, which may be size reduced using tin snips. However, attempting to cut all oversize metal to less than 3/8" can be very time consuming. Because it is required that all ash be screened and processed, the final rules only require performance of the less time-consuming size-reduction method, i.e., breaking up the friable oversize ash. MPCA staff believe this will be adequate to produce representative data which is comparable from year to year, as long as the same size-reduction method is followed consistently. The clause "at a minimum" indicates that reducing the size of oversize ash in addition to friable pieces is acceptable.

Item E requires that oversize ash be re-screened after the size-reduction step required under item D is performed. The purpose of this is to separate ash which is now less than 3/8". If size-reduction is done on top of the screen, this step is not necessary.

Item F requires that the weight of ash remaining on the screen be recorded. The weight of ash which passes through the screen may be determined by subtracting the weight of remaining oversize ash from the initial weight of oversize ash recorded as required by item C. If size reduction is done separate from the screen, both weights should be recorded to double check whether they add up to the original oversize weight recorded under item C.

Item G requires that ash which passes through the screen after size reduction be added to ash which originally passed through the screen. In some

cases this step may already be completed as a consequence of the particle size-reduction method. Item G also requires that all ash which has passed through the screen be thoroughly mixed together. Mixing ash in a clean cement mixer for five minutes or more is an example of a method which MPCA staff believes qualifies as thorough mixing. Mixing ash using shovels and rakes on a clean concrete floor, is also acceptable as long as thorough mixing is achieved. To test a mixing method, sands or other similar materials of different colors can be mixed and used to visually assess the thoroughness of the method. After ash samples have been mixed, analysis samples must be collected from this ash as soon as possible.

Item H requires that samples which will be sent to the laboratory for analysis be taken from the composite samples formed by step G. The containers used to hold ash which is retained to fulfill the requirement of subpart 8, item G should also be filled at this time, so that the retained ash is as similar to the analysis samples as possible. Remaining ash may then be discarded.

10. Subpart 10. Annual Ash Testing Report.

This subpart requires submittal of an annual report containing results of the previous calendar year's testing and discussion of those results. Quarterly reports, as were required under the Temporary Program, are no longer required (with the exception of new facilities, as covered under subpart 11) for a number of reasons. First, MPCA staff previously needed to receive data as soon as it was available for use in developing these rules. After rule adoption this need will no longer exist. One main use of ash testing data will be for monitoring compliance with requirements of part 7035.2885, subpart 4, regarding maximum leachable contaminant levels and, where applicable, subpart 2, regarding exemption from that part. The requirements of part 7035.2885 which relate to test results are concerned with annual averages or median values of an annual data set. Therefore, it is unnecessary to report quarterly information by itself. However, submittal of data at least annually is needed to determine compliance.

A second use for ash testing data will be monitoring reduction in the levels of toxic contaminants in ash over time as required by Minn. Stat. 115A.97. It is the intent of MPCA staff to report to the Legislature the results of this

monitoring as part of the biannual Solid Waste Policy Report which is prepared by MPCA and Office of Waste Management staff. Submittal of data more often than annually is not necessary for this purpose.

Finally, preparation of quarterly reports by owners and operators, and tracking submittal of such reports, unnecessarily uses the operators' and Agency staff's time.

Information regarding the amounts of waste burned, ash produced, metals recovered, and waste received by a facility which was not combusted and required land disposal are required by proposed Minn. Rules pt. 7005.0695 and therefore is not required under these rules. This information will be used by MPCA staff to assess the amount of noncombustibles present in the waste burned and determine progress made towards the goal of reducing the quantity of ash produced as required by Minn. Stat. 115A.97.

The March 15 submittal date for annual reports was selected based on the following considerations:

1. October 22 is the last day a facility may begin sample collection for the fourth quarter under the requirements of subpart 3 (October 15 plus 7 days= October 22).
2. The last day of sample collection would be October 29 (October 22 plus 7 days of sample collection= October 29).
3. Allowing three months for analysis of samples and compilation of the laboratory report adds up to January 29. (In most cases this is completed in two months).
4. Between January 29 and March 15 there are approximately 30 working days. This is an adequate length of time for preparation of the final annual report.

Air Quality rules part 7005.0695, subpart 3, requires submittal of an annual report on April 30 of each year. Waste combustor owners and operators have stated that they would like the due date for the annual report required by this part to be the same, April 30. However, annual reports regarding ash testing will be used by MPCA staff to compile a report for the state Legislature. Experience has shown that it is necessary to start work on the report before April to meet the fall deadline for submittal to the Legislature. Typically, a

draft report must be prepared by early summer to allow adequate time for internal and outside discussion, which often involves a task force and review by a number of outside agencies.

Item B requires that the annual report include discussion of data. In particular, Agency staff would like the report to address whether the levels of toxic contaminants, both total and leachable, have changed since the previous year. This may be assessed by graphing quarterly results or comparing the annual averages for each parameter or both. It is reasonable to require this assessment, because it directly relates to one of the main purposes for collecting ash testing data, as discussed above. The owner or operator is in the best position to make such an assessment, because: 1) they are required by Minn. Stat. 115A.97 and proposed air quality rules to operate their facility to reduce the level of toxic contaminants contained in ash and the quantity of ash to the maximum extent feasible and prudent, and 2) they may know what changes in operation or wastes burned at the facility affected ash test results.

Item C requires that the report include assessment of data quality assurance. This is needed to ensure that conclusions which are drawn regarding changes in ash quality accurately reflect actual changes, and are not due to sampling or laboratory errors or deliberate method changes. A standard list of points which must be considered as part of this data assessment is provided. A qualified laboratory which performs ash sample analysis should be able to provide much or all of the required information to the waste combustor owner or operator. It is reasonable to expect that the quality of the data submitted be known. Also, this requirement serves as a reminder of the importance of data quality assurance. A person who must assess data quality assurance at least once per year as part of an annual report is more likely to closely monitor quality assurance throughout the year, so that they are able to state favorable conclusions regarding data quality.

Item D requires submittal of information regarding operation of the waste combustor during the sampling periods. Because facility operations may affect ash test results, it is reasonable to request that the facility provide the requested information for the Agency to use as part of the data review discussed in the preceding paragraph. This was also required under the Temporary Program, and therefore does not present an additional burden on owners and operators. Agency staff have distributed a form for owner and operators to

complete to comply with this requirement. This form identifies the information that the Agency would like to receive, and improves the ease of data reference for Agency staff.

Item E requires that the annual report include certification that the contents are accurate. This makes one person responsible for making sure the report is properly prepared and contains the correct information. If that person knows that they are personally responsible, they are more likely to take more care in preparing the report.

This item also requires that a responsible person certify that no actions were taken, such as changing the content of waste burned during the sample collection period, which would make ash test results unrepresentative of ash typically generated. The accuracy of data collected from analysis of samples which the owner or operator collects themselves has been questioned. The public is concerned that facility operations may be purposefully altered to reduce the levels of toxic contaminants which are detected in ash. In the future, as owners and operators are under Legislative pressure to further reduce the level of contaminants in ash, the impetus for this type of behavior will be increased. Although Agency staff does not have any evidence that this behavior has occurred, and some owners or operators find this requirement insulting, the requirement is reasonable, as it does not increase the burden of the ash testing program, and helps determine unacceptable behavior which would degrade the purpose of the ash testing program.

The penalty for submitting false data should be loss of the operator's certification. Requiring that a plant operator provide the certification is desirable over requiring certification by a registered engineer, as is required for a number of other certifications, because the owner or operator is most likely to have direct contact with the sampling process and be aware of any irregularities that occurred during a sampling event. Requiring that the report be certified also identifies for Agency staff who to contact in case questions arise regarding data submitted.

11. Subpart 11. Special Requirements for New Facilities.

Existing waste combustors have completed or will soon complete four quarters of testing under the Temporary Program. This testing included quarterly

analysis of samples of bottom, fly, and combined ash for a list of parameters which includes those on the quarterly and annual parameter lists of subpart 4. The results of this quarterly testing serve as the baseline data which will be used by the director to determine which, if any, parameters a waste combustor must analyze for quarterly in addition to those already on the quarterly list. New waste combustors must collect enough data during the first year of operation to serve as baseline data which can be used to establish the appropriate quarterly testing parameters for that facility. For example, chromium is not usually detected in ash from most waste combustors at significant levels. However, if the new waste combustor serves an area which includes an industry whose waste occasionally contains chromium, quarterly testing should identify that ash from that facility may contain chromium. In this case, the Director would require continued quarterly rather than annual analysis for chromium, based on the results of the first year's testing.

The question arises whether new waste combustors should also be required to test bottom and fly ash separately even if they manage only combined ash, as was required under the Temporary Program. MPCA staff believes the answer to this question is no. Results of analysis of bottom and fly ash have been used to set management standards for separate management of bottom ash and fly ash are managed separately, such as the standards of part 7035.2885, subpart 11, items L to N. However, no further regulatory need exists for gathering data on bottom and fly ash separately in cases where a facility manages combined ash.

Item A requires submittal of an ash sampling plan at least 90 days before the first time waste is fired at the facility (i.e., 90 days before initial startup). Review and approval of an ash sampling plan is necessary to ensure that ash samples are collected and processed using acceptable methods. ninety days should allow sufficient time for MPCA staff to review the plan and for the owner or operator to change the plan if necessary.

Item B requires that ash sampling begin within 60 days of reaching the maximum continuous rating for the waste combustor, but not more than 180 days after initial startup. "Reaching the maximum continuous rating" is a term used by Air Quality staff which means operating at full capacity for an extended period of time. When a new waste combustor begins operation it goes through a shake down period during which adjustments to the facility design and operation are made, and the facility does not operate at full capacity. It usually takes

a number of months before the facility operates at full capacity in a manner which will be considered "typical". The deadlines identified in this item strike a balance between the desire to obtain data on ash quality as soon as possible after startup, and the desire to get data which are representative of ash produced during typical operation of the facility.

Item C requires that quarterly samples for the first year be analyzed for the full list of parameters, i.e., the quarterly list plus the annual list, rather than only the shorter quarterly list identified in subpart 4. The reasons for this are given above.

Item D requires that ash reports be submitted on a quarterly basis during the first year. Reports are due three months after the date when sampling begins for that quarter. Quarterly rather than annual reporting is required for new facilities to determine whether ash exceeds the maximum contaminant limits identified in part 7035.2885, subpart 5, and to compare results with the predicted ash quality used in any permits or environmental impact reviews related to ash from the new facility. Three months has been the time period required for submittal of ash testing quarterly reports under the Temporary Program. Except in unusual cases where delay was caused by difficulties with laboratory analyses, owners and operators of waste combustors have been able to meet this submittal schedule.

Item D also requires that the contents of quarterly reports comply with the requirements of subpart 10. This includes discussion of data accuracy and any trends observed, in this case between quarters, information summarizing operation of the waste combustor during the sampling period, and certification of the report by the person responsible for ash sampling at the facility.

12. Subpart 12. Requirements for Exemption from part 7035.2885.

Owners and operators of waste combustors who wish to exempt their ash from the requirements of part 7035.2885 must comply with the requirements of this subpart. In addition to the requirements of subparts 4 and 5 of this part, samples must be analyzed using EPA Method 1311, the TCLP. As described under subpart 4, item B above, the TCLP test simulates the leaching environment waste which is co-disposed with general refuse is subject to. Because part 7035.2885 allows exempted ash to be co-disposed with other wastes, the TCLP is the appropriate leach test for estimating the leaching potential of co-disposed ash.

The number of samples required, six, was selected based on the same considerations discussed under subpart 5 above.

Annual reporting of test results is required. Rather than requiring submittal of quarterly reports to track compliance with regulatory limits, item C requires that the owner and operator notify the Director if an exceedance occurs. If the exceedance is extreme, MPCA staff may require that the owner or operator attempt to determine the cause of the exceedance and whether the ash is expected to continue to exceed exemption standards, in which case the Commissioner may disapprove continued exemption. Quarterly reporting requires extra work by owners and operators and MPCA staff. Therefore, submittal of test results with the annual report is considered adequate.

F. Reasonableness of all-new part 7035.2915: REQUIREMENTS FOR TEMPORARY PROGRAM TYPE I AND II ASH STORAGE FACILITIES

Subpart 1. Definitions.

This subpart defines three terms which are used in this part. Because these terms are not used in other parts of chapter 7035, it is unnecessary to define them in part 7035.0300 along with other terms used throughout the chapter. Defining these terms allows the remainder of the part to flow more smoothly, rather than explaining these three terms each time they are used. The definitions are based on the definitions which exist in the Temporary Program. Slight modifications have been made for clarity, but the substance of the definitions has not changed.

Subpart 2. Scope.

This subpart notifies owners and operators of Type I and II combustor ash storage facilities that they must comply with this part. Table 6 identifies the ash management status of Minnesota waste combustors, including identification of Type I and Type II ash storage facilities.

Subpart 3. Type I Storage Facilities.

Item A requires that Type I (temporary storage only) facilities comply with the storage requirements of part 7035.2855 subpart 3, items A to F, and subpart

4, items A and C, the facility permit, and this subpart. The purpose of this statement is to list all Agency requirements with which such a facility must comply.

Part 7035.2855 contains storage regulations for solid waste. Because municipal solid waste combustor ash is a solid waste, these rules apply to its storage. It is necessary to clarify that part 7035.2855 now applies to municipal solid waste combustor ash because under the Temporary Program special regulations, not the solid waste rules, applied to municipal solid waste combustor ash storage facilities. Part 7035.2855 subparts 1 and 2 do not apply because their requirements overlap and in cases conflict with requirements of the Temporary Program. Subpart 3 specifies design and operation requirements for storage facilities. Subpart 4 specifies storage facility liner inspection requirements. Item B is subpart 4 is not included in this requirement because it requires removal of all waste from the storage area at least annually. This would be impractical for Type I ash storage facilities because of their large size. In addition, the length of use of a Type I storage facility is only a few years, whereas the solid waste storage facilities which item B applies to may be in use for several years. Also, removal of ash annually would increase the potential for fugitive dust emissions; it is preferable to minimize the amount of times ash must be transferred to decrease dust emission potential.

Item B requires that a Type I ash storage facility be closed within 18 months of the effective date of this part in accordance with part 14 and 15 of the Temporary Program, the facility permit, and subitems (1) to (5) of this part, or a closure document.

This subpart requires that Type I facilities close within 18 months of the effective data of the rules because the Temporary Program was never intended to serve as permanent rules. According to part 1.0, subpart 4 of the Temporary Program, the program expires when the Agency adopts rules for incinerator ash. To facilitate a smooth transition between the Temporary Program and the ash rules now being proposed, it is both needed and reasonable to extend the applicability of the Temporary Program for a limited time after the establishment of waste combustor ash rules, and to designate a date after which the Temporary Program is no longer effective.

The statement that a facility must comply with the requirements of its permit states the obvious. Stating that this subpart applies repeats a portion

of subpart 2. However, this reference is included to make the list complete. Including this reference is also important so that the sentence in item B regarding conflicting requirements is true.

A closure document, as defined by part 7035.0300, means an order, stipulation agreement, or other Agency-issued or negotiated document that defines specific closure and postclosure care requirements executed at the time a solid waste management facility is closed. This is included in the list of items which may apply to a type I facility because at one or more the type I ash storage facilities the actions that the Agency will require for closing differ from those required by the other documents listed.

Subitem (1) requires that the Commissioner be notified at least 90 days before facility closure activities are to begin. Notification allows staff to schedule inspections during the closure activities to determine if the activities comply with the requirements of this subpart. Notification also allows the permittee and the Agency time to agree on the closure procedures to be followed based on assessment of the most recent applicable documents.

Subitem (2) requires that ash and contaminated portions of the underlying liner and soils be removed from the site. Staff expects that some leachate will leak into the liner during the operating life of the facility. If the liner does not contain all contaminants as required, subsurface soils may also be contaminated. It is reasonable to expect that the owner or operator remove contaminated soils from the site in order to leave it in an uncontaminated state, in accordance with the intent of the Temporary Program. The testing required by this part has been successfully carried out in the past at Type I ash storage facilities.

Subpart 4. Type II Ash Storage Facilities.

This subpart states that Type II ash storage facilities are classified as disposal facilities. Under Minn. Stat. § 115A.97 and the Temporary Program, the Agency reserved the right to dictate how ash stored during the interim period would be managed after final ash rules became effective. Such management could include removal of ash from Type II ash storage facilities. This subpart dictates that ash does not have to be removed. Agency staff do not believe that evidence currently exists which would justify requiring the removal of ash from

these facilities. Leak detection systems below ash monofill liners have not shown evidence that liners are leaking, and analysis of actual monofill leachate so far has not shown significant levels of toxic metals. In fact, mixed municipal solid waste land disposal facility leachate often contains higher levels of metals than ash leachate (see Appendix XIV). Type II ash storage facilities will continue to be monitored to ensure that if a release does occur in the future, remedial actions can be taken as necessary.

There are six Type II ash storage facilities in Minnesota. A description of each facility is shown in Table 6.

Table 6: Type II Ash Storage Facilities

	Waste Combustor	Type II Facility Name	Liner Design
1.	Fergus Falls	Fergus Falls	4' clay
2.	NSP Red Wing	NSP Red Wing	60 mil HDPE with 1' clay under the base of the center phase of the liner; distance between leachate collection pipes exceeds requirements in some areas due to the "hub and spokes" design of the system
3.	Olmsted	Olmsted-Dodge	3+' clay
4.	Polk	Polk County	4' clay
5.	Quadrant	Northeast Ottertail	60 mil HDPE over 2' clay
6.	Red Wing	Red Wing	60 mil HDPE over 2' clay

As can be seen from Table 6, the current design of four of the Type II ash storage facilities does not completely satisfy the minimum requirements of part 7035.2885, subpart 11, which requires a 60/1000 (60 mil) HDPE flexible membrane liner over at least two feet of clay for a combined ash disposal facility. Rather, in the absence of specific rules pertaining to ash disposal, they were designed to meet one of the two alternative liner designs allowed by part 7035.2815 for MSW land disposal facilities: a single composite liner with a 60/1000 inch HDPE over two feet of clay, or four feet of compacted clay. (In both cases clay must be compacted to no greater than $1x10^{-7}$ cm/sec). Three of the facilities are not equipped with synthetic membrane liners. NSP Red Wing has a synthetic membrane liner, but does not include 2' of clay beneath the synthetic membrane. NSP's alternative design was deemed acceptable by the

Agency in light of NSP's demonstration that the soils underlying the site have a very high potential to attenuate migration of metals due to their high cation exchange capacity.

Proposed part 7035.2885 requires that ash disposal facilities constructed in the future incorporate a composite liner in their design. Composite liners which are carefully placed and protected from puncture offer an increased degree of environmental protection over clay-only liners. However, clay liners still provide a significant degree of environmental protection. A liner constructed in accordance with part 7035.2815 must have an efficiency of at least 95 percent. That is, the liner must collect 95 percent or more of the precipitation which falls on an open cell and becomes leachate. Although there is some evidence that certain leachates may cause clay permeability to increase, there is also evidence to the contrary, as discussed above in part 7035.2885, subpart 11.

In summary, the folling reasons are presented as the basis for the Agency's determination that type II ash storage facilities will be classified as permanent disposal facilities:

1. Ash monofill leachate contains equal or lesser amounts of pollutants than leachate from mixed municipal solid waste land disposal facilities. All type II ash storage facilities comply substantially with the minimum standards of part 7035.2815 which apply to mixed municipal solid waste land disposal facility.
3. Removal of ash from type II ash storage facilities would constitute a significant cost burden for owners and operators of such facilities, including the cost of excavation, transportation, and disposal.
4. Although actions may be taken to minimize fugitive dust emissions, it is desirable to avoid unnecessarily exposing and handling ash as would be necessary to remove all ash from the facility.
5. Environmental monitoring systems installed at type II ash storage facilities, including leak detection lysimeters and ground water monitoring wells, have not shown evidence of contamination.

V. ECONOMIC CONSIDERATIONS

The Agency is required to take economic matters into account in its rulemaking activities:

> In exercising all its powers the pollution control agency shall give due consideration to the establishment, maintenance, operation and expansion of business, commerce, trade, industry, traffic, and other economic factors and other material matters affecting the feasibility and practicability of any proposed action, including, but not limited to, the burden on a municipality of any tax which may result therefrom, and shall take or provide for such action as may be reasonable, feasible, and practical under the circumstances.

Minn. Stat. sec. 116.07, subd. 6

This law has general applicability to all actions of the Agency. In the rulemaking context, this law has been interpreted by the Agency to mean that, in determining whether to adopt proposed rules or amendments, the Agency must consider, among other evidence, the impact which economic factors may have on the feasibility and practicability of the proposed rules or amendments. In the Proposed Revision to Minn. Rule APC 1, 6 MCAR sec. 4.0001. Relating to Ambient Air Quality Standards, the Agency discussed the requirements of Minn. Stat. sec. 116.07, subd. 6 as follows:

> In order for the Agency to duly consider economic factors when it determines whether to adopt the amendments to Minn. Rule APC 1, the record upon which the Agency will make its determination must include data on the economic impacts of those amendments. These economic impacts, however, need not be quantified with absolute certainty in order to be considered. Further, these economic impacts may include costs other than the cost of complying with a proposed rule. For instance, material losses, crop losses, health costs, and impacts on tourism are also economic factors that should be duly considered by the Agency in determining whether to adopt the amendments to Minn. Rule APC 1.

The law clearly requires that the present analysis be limited to factors that have determinate, though not necessarily quantifiable, economic impacts. This analysis does not cover the full range of effects that will result from the changes proposed for the State's solid waste management system. For example, other sections of this document have discussed physical effects. The administrative implications of the proposed rules are implicitly throughout the

document. A concerted effort could likely develop a list of dozens of other factors associated with the proposed rules as either direct or indirect causes or effects. However, reasonable analysis must recognized the constraints imposed by data and resource limitations. This is why the present applied analysis strictly follows the statutory guidelines and considers only determinate economic impacts.

The economic impacts of the proposed rules were estimated with the use of a statistical model of the state's economy. The Minnesota Economic and Demographic Forecasting and Simulation Model (EDFS-53) built by Regional Economic Models, Inc. of Amherst, Massachusetts (REMI) is owned by the Minnesota Department of Revenue. The model is used by other state departments by special arrangement with the Department of Revenue. The model divides the state's economy into 53 industrial sectors (based on the federal government's Standard Industrial Classification codes) and 202 population age/sec cohorts. Through the use of over 1,000 policy variables, the model can simulated the economic effects of changes in the region. The difference between the control forecast and the simulation (simulated forecast) for each of the sectors of the economy is the impact on each sector of the increased (or decreased) economic activity in the state.

Direct cost estimates for the proposed rules (e.g., ash testing costs) were added to the operating costs of regulated sectors and to the revenues of service sectors (e.g., testing laboratories). The details of the simulation study are presented in Appendix XXIV.

The results of the simulation show that the proposed rules will have only a negligible impact on the state's economy. The simulation shows employment increases for the first few years of the analysis. This is followed by slight employment declines in the later years. However, even the largest of the increases amounts to only 0.02 percent of total employment. Likewise, the largest of the changes in total economic output is less than 0.01 percent of total output. Personal income changes are forecast to have the same order of magnitude.

The simulation indicates some positive economic effects, but they can hardly be considered as economic development. On the other hand, the simulation indicates some negative economic results, but these are so small they cannot be considered as signs of imminent recession. The impacts forecast are slight because the factors being influenced are so large by comparison.

This finding should not be minimized. Reviewers of the proposed rules sometimes maintain that the rules will impose an unbearable burden on regulated firms and local governments. These assertions have validity only if the point of view is constrained to a very narrow economic sector and for a limited time. A limited point of view often makes problems, questions and issues seem simpler. Cutting back on the number of variables considered makes it easier to come to decisions. But accepting narrow limits constrains analysis, sometimes to the point that critical information is ignored. The results are flawed analyses and incorrect findings.

The broadened point of view taken for this analysis conforms with the law that requires the agency to consider economic impacts. Given this point of view, the agency finds that the proposed rules will have negligible effect on the state's economy.

VI. SMALL BUSINESS IMPACTS

The Agency has considered impacts of the proposed rules on small businesses. The Agency's findings are discussed in Appendix XXV.

VII. IMPACTS ON AGRICULTURAL LANDS

The Agency is required to consider the impacts of proposed rules on agricultural lands:

> If the Agency proposing the adoption of the rule determines that the rule may have direct and substantial adverse impact on agricultural land in the state, the Agency shall comply with the requirements of sections 17.80 to 17.84

Minn. Stat. § 14.11, subd. 2 (1988)

The definition of adverse impact which applies in this case is:

> "Action which adversely affects" means any of the following actions taken in respect to agricultural land which have or would have the effect of substantially restricting the agricultural use of the land: (1) acquisition for a nonagricultural use except acquisition for any unit of the outdoor recreation system described in section 86A.05, other than a trial described in subdivision 4 of that section; (2) granting of a permit, license, franchise, or other official authorization for nonagricultural use; (3) lease of state-owned land

for nonagricultural use except for mineral exploration or mining; or (4) granting or loaning of state funds for purpose which are not consistent with agricultural use.

Minn. Stat. § 17.81, subd. 2 (1998)

The Legislature has set agricultural land policies that guide administrative agencies' rulemaking efforts and determinations of adverse impact:

> It is the policy of the state to preserve agricultural land and conserve its long-term use for the production of food and other agricultural products by:
>
> (a) Protection of agricultural land and certain parcels of open space land from conversion to other uses;
> (b) Conservation and enhancement of soil and water resources to ensure their long-term quality and productivity;
> (c) Encouragement of planned growth and development of urban and rural areas to ensure the most effective use of agricultural land, resources and capital; and
> (d) Fostering of ownership and operation of agricultural land by resident farmers.

Min. Stat. § 17.80, subd. 1 (1988)

The Agency finds that the proposed rules will not cause any adverse impacts on agricultural lands. The proposed rules apply to owners and operators of waste combustors which burn mixed municipal solid waste. Although the practice is discouraged or prohibited, farmers, like other persons who burn waste generated on-site, are not burning mixed municipal solid waste, and therefore are not subject to regulation under the proposed rules.

The rules are designed to protect land surrounding facilities which manage municipal solid waste combustor ash. Specific requirements for controlling fugitive dust emissions at ash land disposal facilities and from vehicles carrying ash are included in the proposed rules. Standards are also included which protect ground water.

VIII. CONCLUSION

The Agency staff has in this document made its presentation of facts establishing the need for and reasonableness of the proposed new rules and rule amendments governing management of ash from combustors which burn municipal

solid waste. This document constitutes the Agency statement of need and reasonableness for the proposed rule amendments.

Based on the foregoing, the proposed changes to Minn. Rules pt. 7001 and 7035 are both needed and reasonable.

Dated: 5/10/91, 1991

Charles W. Williams
Commissioner